Rowell Creek/Mill Creek/Rickreall Creek/Luckiamute River Watershed Analysis

Marys Peak Resource Area
Salem District, Bureau of Land Management
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The analysis portion of this project was conducted from summer 1997 through spring 1998. A first iteration of this document was completed in September 1998. The analysis generally follows the federal guide for watershed analysis (Version. 2.2, August 95) although some modifications were made, such as combining chapters to reduce redundancies. This is a document which is still evolving and will be updated as new information becomes available. The data in this document were the best available, although in some cases there were little relevant data available. Management opportunities for this analysis area must be considered in light of the checkerboard land ownership pattern of BLM-administered land; cooperative programs with adjacent ownerships are necessary to achieve optimum results in restoration opportunities. No warranty is made as to the accuracy, reliability or completeness of the data or maps contained herein.

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Preface

The Northwest Forest Plan (NFP) is a regional ecosystem management plan which was initiated in 1994 by federal land management agencies. The plan requires that watershed analyses be completed on all federal lands within the range of the northern spotted owl. Watershed analysis provides the foundation-laying data structure needed to support the ecosystem management objectives described in the NFP. It also enhances the agencies' abilities to move away from species and site-specific management, and towards systems management. Although watershed analysis is not a decision-making process, the results of a watershed analysis establish the context for subsequent decision-making processes, including planning, project development, and regulatory compliance.

Most NFP watershed analyses focus on one fifth-field watershed and the subwatersheds located within it. This watershed analysis, however, will focus on seven subwatersheds located within the following four fifth-field watersheds (listed from N to S): the South Yamhill River, Mill Creek, Rickreall Creek, and the Luckiamute River. All of the lands, both federal and private, contained within the four adjacent fifth-field watersheds will be referred to as the "**megawatershed area**" (See Map 1, p. C-2); the seven conterminous subwatersheds, which contain 96% of the BLM lands within the megawatershed, will be collectively referred to as the "**analysis area**" (See Map 2, p. C-3). Where appropriate, specific watersheds or subwatersheds will be referenced if actions, their impacts, or other issues warrant a more detailed approach.

The primary reasons for combining four fifth-field watersheds into one analysis are (1) the small amount of federal ownership, primarily Bureau of Land Management (BLM) lands, and (2) the fragmented nature of this ownership. It was also felt that the ecology and issues within the upland forest environment associated with these watersheds are not significantly different to justify separate analyses. If pivotal differences surface during the course of this analysis, then it may be necessary in future analyses to further subdivide this boundary.

This analysis is tiered to the following documents (for full citations, see "References"):

1. *Final Supplemental Environmental Impact Statement on Management of Habitat for Late-successional and Old-growth Forest Related Species within the Range of the Northern Spotted Owl, Vols. I and II.* (The *Northwest Forest Plan)*. (USDA-USDI 1994b)

2. *Salem District Record of Decision and Resource Management Plan (ROD/RMP)*. (USDI-BLM 1995)

3. *Assessment Report for Federal Lands In and Adjacent to the Oregon Coast Province* (USDA 1995)

4. *Late-Successional Reserve Assessment for Oregon's Northern Coast Range Adaptive Management Area* (USDA-USDI 1997a)

5. *Northern Coast Range Adaptive Management Area Guide* (USDA-USDI 1997b)

6. *Ecosystem Analysis at the Watershed Scale: Federal Guide to Watershed Analysis* -

Version 2.2 (REO 1995)

Special note to our publics: The Salem District of the BLM requested public input (via radio, newspapers, and meetings) in the spring of 1997 on issues and management suggestions related to the analysis area. Although this report will be shared with any interested person or group, it is primarily an internal (federal) working document, and many of the terms and concepts found in it have their origin in one of the documents listed above. If you are not familiar with these documents, you may experience some difficulty in following the process of this analysis. Copies of the documents listed above are available for review at the Salem District Office.

MAPS

Note:

There are two sizes of maps in this analysis document:

Text Maps are 8½" X 11" and are included in the body of the document.

Map Packet maps are 11" X 17" and are found separately at the end of the document.

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ACRONYMS

There are numerous acronyms used in this document; this list contains the ones most commonly used.

Acronym	**Meaning**
ACEC	Area of Critical Environmental Concern
ACS	Aquatic Conservation Strategy
AMA	Adaptive Management Area
BBF	Billion Board Feet
BLM	Bureau of Land Management
BMP	Best Management Practices
CFR	(United States) Code of Federal Regulations
CWD	Coarse Woody Debris [Note: Fish biologists often use the term "large woody debris" for pieces of large wood in the water. This document was written to be consistent in use of terminology with the Northwest Forest Plan and the *Salem District Record of Decision/Resource Management Plan*; in both of those documents, CWD is used to refer to any large down wood regardless of whether it is on the ground or in water.]
DBH	Diameter (at) Breast Height
DEQ	(Oregon) Department of Environmental Quality
EA	Environmental Assessment
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
GIS	Geographic Information System
IDT	Interdisciplinary Team
LSOG	Late-seral/old-growth
LSR	Late-Successional Reserve

LSRA	Late-Successional Reserve Assessment (for Oregon's Northern Coast Range Adaptive Management Area)
LUA	Land Use Allocation
MBF	Million Board Feet
NFP	Northwest Forest Plan
NMFS	National Marine Fisheries Service
ODFW	Oregon Department of Fish & Wildlife
OFPA	Oregon Forest Practices Act
OHV	Off-Highway Vehicle
ONA	Outstanding Natural Area
RIA	Rural Interface Area
RMP	(Salem District Record of Decision and) Resource Management Plan
RNA	Research Natural Area
RPA	Reserve Pair Area
RR	Riparian Reserve
SAS	Special Attention Species
SFP	Special Forest Products
SSS	Special Status Species
TMO	Transportation Management Objectives
TPCC	Timber Production Capability Classification
TSZ	Transient Snow Zone
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFS	United States Forest Service
VRMA	Visual Resource Management Area

WA	Watershed Analysis
WQ	Water Quality

Executive Summary

IDT Management Recommendations

The following five Management Recommendations were synthesized by the Watershed Analysis Interdisciplinary Team from a large list of resource-specific recommendations which were compiled by each team specialist. These recommendations are considered by the IDT to be the most important ones for the analysis area at this time.

Recommendation: Enhance Late-Successional & Old-Growth Forest Characteristics

A. **Survey existing suitable habitat**, **inventory early and mid-seral stands** for development of LSOG characteristics, and use the data to design treatments which increase **nesting opportunities for marbled murrelets**. (These treatments will also have a beneficial impact on the nesting, foraging, roosting, and dispersal of other LSOG dependent species by increasing the amount and complexity of coarse vertical and horizontal structure.)

B. Improve **connectivity** in riparian and upland forest habitats for all LSOG dependent species.

C. Inventory all stand modification activities in early and mid-seral stands for Special Habitat Component conditions, and where they are deficient, create these **Special Habitat Components** (snags, coarse woody debris, wolf trees, multi-layered canopies) in riparian and upland forest habitats.

Recommendation: Water Quality

A. **Inventory all roads for risk(s)** of contributing to cumulative effects to the aquatic ecosystem. Factors to consider include proximity to the riparian zone, hill-slope stability, transient snow zone, road maintenance and use, and age and construction methods.

B. **Improve drainage systems on roads** in order to return intercepted water to hillslopes by outsloping the road surfaces and by installing extra cross drains, water bars, and drain dips.

C. **Analyze stream crossings** for diversion potential to determine their priority for upgrading (by construction of deep dips, armoring fill slopes, installing larger culverts, or outsloping roadways).

D. Analyze the potential engineering construction opportunities at stream crossings to allow debris flows to continue downstream. Determine the feasibility for **upgrading stream crossing culverts** for fish passage.

Recommendation: Forest Peak ACEC

Adjust the boundary of Forest Peak ACEC by extending it to the BLM property line (southwest corner), adding 26 acres to the size of the ACEC.

Recommendation: Land Tenure

Create a Salem District Land Tenure IDT to determine, at a Coast and Cascade Range Province level, the best give-and-take exchange strategy for the 9.9 thousand Salem District acres of Land Tenure Zone 3 lands (*Salem District ROD/RMP*, USDI, BLM 1995).

Recommendation: Size of the Megawatershed Analysis

In any further iterations of this watershed analysis, **divide the current megawatershed** into two smaller analysis areas by separating the Luckiamute watershed from the South Yamhill/Mill/Rickreall complex.

Location & Size

The ***Rowell Creek/Mill Creek/Rickreall Creek/Luckiamute River Watershed Analysis*** covers a large area which combines four fifth-field watersheds (395,480 acres), herein termed the "**megawatershed area**" (See Map 1, p. C-2). The megawatershed was stratified into an "**analysis area**," the focus of this report (containing 96% of the BLM lands in the megawatershed), and the lower elevation lands outside the analysis area. (See Map 2, p. C-3)

The megawatershed area is located west of Salem, Oregon, primarily in Polk County (See Map 1, p. C-2), and is in the northern portion of the Oregon Coast Range Physiographic Province and within the Middle Willamette Drainage Subbasin of the Willamette River Basin. It lies south of Hwys. 22 and 18 and north of Hwys. 20 and 34. The western boundary runs along the summit of the Oregon Coast Range, with all hydrologic flows eventually reaching the Willamette River to the east. Local communities within the megawatershed include Dallas, Falls City, Monmouth and Independence. The analysis area is 142,169 acres (36% of the megawatershed) and is located in the western half of the megawatershed, primarily above the 1,000 feet elevation level. There are no local communities within the analysis area.

Six isolated BLM parcels, totaling 1,152 acres, occur in the megawatershed but are outside the boundary of the analysis area (See Map 2, C-3). Five of these six parcels will not be evaluated as part of this analysis. If management actions are proposed in these five parcels, an analysis will be done to link, if possible, their site-specific evaluations with the most appropriate watershed/subwatershed analysis. The sixth, and most southerly parcel, located in the Luckiamute River watershed, contains the Forest Peak Area of Critical Environmental Concern. This special area has its own management plan, and this parcel will be addressed in the analysis.

Land Tenure

Over the last century, the forests of the Oregon Coast Range have been claimed by private, corporate, county, state, and federal landowners. Today in the analysis area, there are five major and five minor landowners (See Map 3, p. C-4). Land ownership in the analysis area occurs as follows: private, 80% (113,437 acres); BLM, 18% (25,956 acres); State, 1% (1,640 acres); and US Forest Service, 1% (1,136 acres).

The *Salem District ROD/RMP* defines Land Tenure Zones 1, 2 and 3 as guides in the selection of BLM lands for exchange, sale, transfer, or acquisition. Within the analysis area, there are 25,741 acres of Zone 2 lands, and 215 acres of Zone 3 lands. Lands in Zone 2 are typically checkerboard lands and cannot be sold, but they can be exchanged or transferred. They are second in priority for blocking-up to increase stand sizes. Lands in Zone 3 are the most scattered and isolated in the District; these parcels can be sold, transferred or exchanged. There are four isolated (from other Forest Service lands) parcels of Siuslaw National Forest totaling 1,136 acres adjacent to BLM lands in the northeast part of the analysis area.

Land Use Allocations

Northwest Forest Plan federal land use allocations in the analysis area are as follows: Late-Successional Reserves, 90% of total federal acres (24,431 acres); Adaptive Management Area, 10% (2,661 acres); Riparian Reserves cover 52% of the LSR (12,705 acres) and 46% of the AMA (1,222 acres); and Reserve Pair Areas, 28% (7,682 acres). Additional *Salem District ROD/RMP* land use allocations within the megawatershed area are: Visual Resource Management Area Class 1 lands = 0 acres, Class 2 = 573 acres, Class 3 = 2,103, and Class 4 = 23,716; Rural Interface Area lands = 1,090 acres (BLM lands within one-half mile of private land home owners). (See the following maps: 4, p. C-7; MP-4; 5, p. C-8; 6, p. C-10; and 7, p. C-11.)

Landscape Relationships

The analysis area lies within several larger scale hydrologic, physiographic, and management (LSRs & AMAs) landscapes. The Northwest Forest Plan (NFP) provides direction for all federal forest lands at the regional level. The NFP identifies "physiographic provinces," "hydrologic province planning and analysis areas," "assessments" for LSRs, and "plans" for AMAs. This analysis area falls within the Willamette Hydrologic Province Planning and Analysis Area, Oregon Coast Range Physiographic Province, Late-Successional Reserve Assessment for Oregon's Northern Coast Range Adaptive Management Area, and the Northern Coast Range Adaptive Management Area Guide (See Map 8, p. C-12). Currently, there are no comprehensive plans available for either the Willamette Province Planning and Analysis Area or the Oregon Coast Range Physiographic Province. Management direction for the analysis area at the province level comes primarily from the standards and guidelines found in the regional Northwest Forest Plan.

The final draft of the *Late-Successional Reserve Assessment of Oregon's Northern Coast Range Adaptive Management Area* (LSRA) was approved in February of 1998. The highest priority objectives of the LSRA are: 1) securing the best late-successional habitat; 2) developing corridors connecting the best habitats together; and 3) protecting the most critical fish habitat. Landscape Zones and Landscape Cells were delineated to help prioritize areas for treatment. The analysis area was designated as the Southern Corridor Zone, which is intended to provide a key connectivity function to the surrounding LSR network, as well as to adjacent state and private lands. The analysis area provides the closest federally managed land link from this landscape to LSR RO268 to the south (the Marys Peak area). Mixed Seral and Early Seral Landscape Cells were identified in the analysis area, and direction is given in the LSRA for treatment priorities and management goals by cell type.

AMAs were designated to encourage the development and testing of silvicultural and social approaches to reaching ecological, economic, and other social objectives. The primary emphasis for management in the

Northern Coast Range Adaptive Management Area is for the restoration and maintenance of late-successional forest habitat, consistent with marbled murrelet guidelines noted for this AMA in the NFP. The *Northern Coast Range Adaptive Management Area Guide* was prepared to help the public, the scientific community, and federal land managers work together in planning and implementing AMA activities. The guide suggests working in and adjacent to late-successional stands with the hope that plants and animals will expand into the younger stands as they develop LSOG characteristics.

Soils

A significant difference in soils and soil processes exists between the northern and southern halves of the megawatershed, and thus the analysis area, due primarily to different parent materials. Human activities, especially timber harvesting and associated road building during the 1940-1960 period, have caused an increase in the number and magnitude of soil compaction and displacement events. The Mill Creek and Rickreall Creek subwatersheds have sustained the highest loses in soil productivity. They comprise only 13% of the analysis area but are the site for 57% of all landslides (See map MP-2). The potential for moderate to severe surface erosion or landslides exists on all slopes greater than 60%, which account for 6% of the analysis area (See map MP-1).

Water

Public lands comprise a small portion (18%) of the analysis area, and hydrologic conditions and trends will be driven primarily by management of private forest landowners. As a consequence, only data from Mill Creek, where BLM land is most concentrated, were analyzed in depth for this report. The average mean annual discharge for Mill Creek during the analysis period was estimated at 148 cubic feet per second. Peak flow for Mill Creek was recorded on December 22, 1964 at 6,170 cfs. The average unit baseflow for Mill Creek in August during the analysis period was 6.2 cfs. The transient snow zone (TSZ) is particularly vulnerable to extremes in storm events and represents an area of high risk for road construction and timber harvest. BLM manages 33% (in some subwatersheds up to 64%) of the land in the TSZ although only 18% of the lands in the analysis area are BLM lands.

While not comprehensive, field investigations to date indicate that "source" and "transport" reaches have higher sediment loads and reduced roughness, particularly from coarse down woody debris, relative to reference conditions. Many of the transport and source channels are aggraded and widened, probably due to an increased rate of disturbance from human-caused processes. Nearly all of the observed "response" and "depositional" channels in the analysis area are moderately to highly unstable.

Current data imply that water quality in the megawatershed is, with some notable exceptions, generally unacceptable and probably degraded from reference condition. The State lists parts of Mill Creek, Rickreall Creek, and the Luckiamute River as "water quality limited," while sections of eight streams in the megawatershed are listed as a "water body of concern" (See map MP-9). Most of the available data are connected with stream reaches below the forests of the analysis area but within the megawatershed area. Clearcuts, logging roads, and related landslides can deliver sediments to forest streams in the analysis area, especially in landslide prone drainages like the upper Mill Creek and Rickreall Creek subwatersheds. Some bank erosion was observed on "response" type reaches in the forested uplands of the analysis area. Stream temperatures and related dissolved oxygen concentrations can be impacted, especially in small headwater streams, by disturbance to overhead and adjacent shade-producing, soil-stabilizing vegetation. During 1997 baseflows, stream temperatures for Mill Creek, at the lower end of the analysis area, were above basin maximums set by State regulations.

There are four municipal watersheds in the megawatershed area (See map MP-9): 1) Dallas draws surface water directly from Rickreall Creek for treatment while the Mercer Reservoir provides regulated flow for summer diversions by the city and agricultural users; 2) Falls City draws surface water for treatment from Teal Creek and Camp Kilowan Spring; 3) Monmouth draws surface water for treatment from Teal Creek; and 4) Sheridan draws its water from the South Fork of the Yamhill to which Rowell Creek is tributary.

Vegetation

During reference conditions, high intensity, stand-replacement fires occurring at irregular intervals of 150-400 or more years (Teensma et al. 1991) affected the forests of the megawatershed area. Logging has manipulated the analysis area towards the younger seral stages in which it exists today (See map MP-3). The analysis area is 96% early and mid-seral (less than 80 years-old) stages. The majority of the analysis area is dominated by coniferous forests and lies within the Western Hemlock Plant Association Zone. The conifers within this zone primarily consist of Douglas-fir, western hemlock and lesser amounts of western redcedar, and at lower elevations (500 ft.), grand fir. Red alders and big-leaf maples are common adjacent to larger order streams. Groundcover consists mainly of salal on the ridges and dry, south-facing slopes, and sword fern on the north slopes and midslopes and even lower if sub-surface moisture is available. Noble fir plant associations may be found on the western edges of the analysis area on peaks and ridges above 2,500 feet.

Federal Riparian Reserves, as defined in the NFP, constitute 50% of the federal lands in the analysis area (See map MP-4). Riparian Reserve stands in the analysis area are generally lacking in LSOG forest characteristics such as large trees, diverse species, multi-layered canopies, snags, coarse woody debris, and scattered open patches. Federal Riparian Reserves and State regulated stream buffers on private and State forest lands will provide a measure of connectivity within the analysis area and to adjacent watersheds in the north, west, and south (See map MP-5). Existing riparian vegetation is providing adequate shade for 77% of all stream miles in the analysis area (See map MP-6). The potential for hard, coarse down woody debris to enter streams is low for the entire analysis area due to the large amount of adjacent early and mid-seral forests (See map MP-7).

Plants, Fish & Wildlife

There are no plant Special Status Species (Endangered Species Act listed; BLM listed as Sensitive or Assessment) known to occur in the analysis area on BLM lands. There are 13 Special Attention Species (SAS; *Salem District ROD/RMP* listed) lichens and 5 SAS fungi known to occur in the analysis area (there are many more SAS suspected to occur in the analysis area). The analysis area contains a few plant species that are considered uncommon and of special interest. Some of these plants are protected under the Oregon Wildflower Law: *Calypso*, *Erythronium*, and *Rhododendron* occur in the analysis area, and *Calochortus* may also. There are at least eight known species of noxious weeds that occur in the analysis area. They can all be found in disturbed areas; five are widespread, while the remaining three are less common. There is one special botanical area, Forest Peak ACEC/RNA, designated in the megawatershed (but it is outside of the analysis area), and there are three special botanical areas designated within the analysis area: Little Grass Mountain ACEC/ONA, Little Sink ACEC/RNA, and Rickreall Ridge ACEC.

Two fish species known to occur in the megawatershed, spring chinook salmon and winter steelhead trout, are proposed for Endangered Species Act listing as threatened. Native Oregon Coast Range cutthroat trout are currently State listed as a stock of concern. Public lands in the analysis area provide only 57.9 miles of resident fish habitat, and very little anadromous fish habitat, only 1.7 miles. Human activities in the analysis area, especially timber harvest and road construction, have had a cumulative negative impact on fish habitat. Among the most significant impacts are the lack of coarse woody debris in streams, increased soil movement, barriers to fish migration, and the loss of conifers in the riparian zone. Five of the seven subwatersheds in the analysis area were surveyed for condition of streambed substrates, abundance of coarse woody debris in the stream channel, and area and quality of pools at baseflows. Many of the stream reaches surveyed were lacking in an adequate number of functional pools, structural complexity in the stream channel, and structure in existing pools.

The following terrestrial invertebrate and vertebrate taxa are considered to be wildlife Special Status Species in the analysis area at this time: earthworms, 1 species; snails, 1 species; slugs, 2 species; amphibians, 13 species; reptiles, 1 species; birds, 4 species; mammals, 7 species. Big game species are considered priority species (*Salem District ROD/RMP*) because the conditions and trends of their populations are considered to be socially and economically important to many Oregonians. Black bear, black-tailed deer, Roosevelt elk, and cougar are all present in the analysis area.

Under current land ownership and usage conditions, the landscape has lost its historic late-successional/old-growth (80+ years) matrix component and is now highly fragmented by a conglomeration of early (0-39 years) and mid-seral (40-79 years) patches representing a wide range of size and age classes. Lacking a matrix to provide some connectivity, the corridor element of streams-riparian zones-roads provide some limited connectivity between patches. Special habitats such as wet and dry meadows, wetlands, and grass balds are scattered throughout the area. There are no known significant caves, cliffs or talus slopes in the analysis area. Special habitat components such as large snags and coarse woody debris have been greatly reduced over the last century throughout the analysis area.

Human Uses

Timber harvesting has been, and continues to be, the major human use in the analysis area: within the last 95 years, billions of board feet of timber have been removed. Clearcutting on private and State lands occurs in the mid-seral (40-79 years) age class, usually followed by burning and replanting. Emphasis on the maintenance of habitat for both terrestrial and aquatic late-successional/old-growth dependent species on federal lands has abruptly shifted management objectives away from timber production. Density management (selective thinning and possibly other treatments) in early and mid-seral stands will be used where appropriate to accelerate the attainment of late-successional/old-growth forest characteristics on BLM and US Forest Service lands. Federal lands will continue to provide opportunities to manage for multiple commodities, especially in the AMA; however, the amounts will be significantly reduced from past levels. As logging roads opened up the area, a number of minor uses have developed over time. The harvesting of special forest products such as firewood, salal, mushrooms, moss, and edibles/medicinals occurs throughout the analysis area. Hunting, primarily for deer and elk, and fishing are the major recreational activities.

Chapter I: Characterization

Location & Size

The ***Rowell Creek/Mill Creek/Rickreall Creek/Luckiamute River Watershed Analysis*** covers a large, four-watershed landmass herein termed the "**megawatershed area**" (see the Preface for more details on the megawatershed and analysis areas). This report will focus on an "**analysis area**" defined by the boundary of the following seven conterminous subwatersheds (from N. to S.) located within the megawatershed area: **Rowell Creek, Mill Creek, Upper Rickreall Creek, Rickreall Creek, Upper Luckiamute River, Little Luckiamute River,** and **Clayton/Pedee Creeks**. See vicinity Maps 1 and 2, pp. C-2 and C-3, for graphic representations of the relationship between the megawatershed area and the analysis area.

The megawatershed area is 395,480 acres and is located primarily in Polk County, west of Salem, Oregon. It lies in the northern portion of the Oregon Coast Range Physiographic Province and within the Middle Willamette Drainage Sub-basin of the Willamette River Basin, south of Hwys. 22 and 18, and north of Hwys. 20 and 34. The western boundary runs along the summit of the Oregon Coast Range, with all hydrologic flows eventually reaching the Willamette River to the east. Local communities within the megawatershed include Dallas, Falls City, Monmouth, and Independence.

The analysis area is 36 percent (142,169 acres) of the megawatershed area and is located in the western half of the megawatershed, primarily above the 1,000 feet elevation level. There are no local communities within the analysis area.

The analysis area contains 96 percent of all BLM land within the megawatershed. Six isolated BLM parcels (totaling 1,152 acres) occur in the megawatershed but are outside the boundary of the analysis area (see Map 2, p. C-3); five of these six parcels will not be evaluated as part of this analysis. If management actions are proposed in these five parcels, an analysis will be done to link, if possible, their site-specific evaluations with the most appropriate watershed or subwatershed analysis. The sixth, and most southerly parcel, located in the Luckiamute River watershed, contains the Forest Peak Area of Critical Environmental Concern. This special area has its own management plan and will be addressed in the analysis.

Land Tenure

The upland conifer forests of the Oregon Coast Range were unencumbered during reference conditions. The Native Americans who lived along the Oregon Coast, the lower Columbia River and the Willamette Valley were so successful at fishing-hunting-gathering in these areas that they spent relatively little time, and had no permanent dwellings, in the upland conifer forests of the Coast Range. Over the last century, the forests of the Oregon Coast Range have been claimed by private, corporate, county, state, and federal landowners.

Today, the forests of the analysis area have been fragmented under the management of four major

MAP 1: MEGAWATERSHED AREA VICINITY MAP GOES HERE

MAP 2: ANALYSIS AREA VICINITY MAP GOES HERE

MAP 3: LAND TENURE GOES HERE

and five ‘minor’ landowners, plus numerous small to medium parcels in different private ownerships [see Map 3, p. C-4 (the category ‘other’ covers these smaller private ownerships)]. The majority of the land in the analysis area is in private ownership (80%, or 113,437 acres; see figure I-1 below). The BLM controls less than one-fifth of the lands in the analysis area (18%, or 25,956 acres); the USFS and the State of Oregon each manage less than one percent of the analysis area land base.

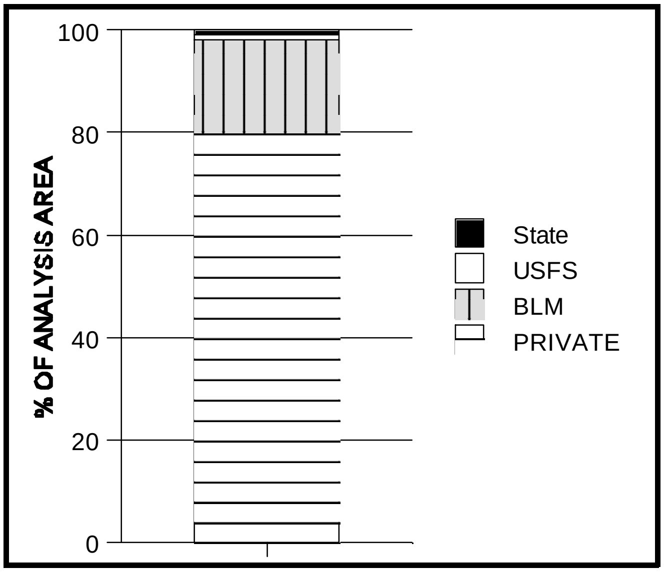

Figure I-1. Land Tenure by Major Type of Landowner in the Analysis Area.

The *Salem District ROD/RMP* defines Land Tenure Zones 1, 2 and 3 as guides in the selection of BLM lands for exchange, sale, transfer, or acquisition. Within the analysis area there are no Zone 1 lands, 25,741 acres of Zone 2 lands, and 215 acres of Zone 3 lands. Lands in Zone 2 are typically checkerboard lands and cannot be sold, but they can be exchanged or transferred. They are second in priority for blocking-up to increase stand sizes. Lands in Zone 3 are the most scattered and isolated in the District; these parcels can be sold, transferred or exchanged. There are four isolated (from other Forest Service lands) parcels of Siuslaw National Forest totaling 1,136 acres adjacent to BLM lands in the northeast part of the analysis area.

Land Use Allocations

Most of the private and State lands in the analysis area are managed for timber production, but there are some private lands at the lowest elevations which are agricultural and residential. Forests on private lands are harvested in the mid-seral (40-79 years) stage of successional/habitat development. These lands provide a continuously changing mix of early and mid-seral patches of different shapes and sizes across the analysis area landscape. At this time, there is no coordination between the different landowners to minimize disturbance and fragmentation at the watershed or landscape level.

The Northwest Forest Plan designated four major land use allocations (LUAs) for federal lands in the analysis area: Late-Successional Reserves (LSRs), Adaptive Management Areas (AMAs), Riparian Reserves (RRs), and Reserve Pair Areas (RPAs). There are 27,092 acres of federal land in the analysis area, of which 90 percent is LSR (24,431 acres) and 10 percent is AMA (2,661 acres). Riparian Reserves cover 52 percent of the LSR (12,705 acres) and 46 percent of the AMA (1,222 acres); Reserve Pair Areas cover

28 percent of the area (7,682 acres). Like RRs, RPAs overlay both LSR and AMA, and RPAs and RRs can overlay each other. Figure I-2 (below) portrays these relationships graphically.

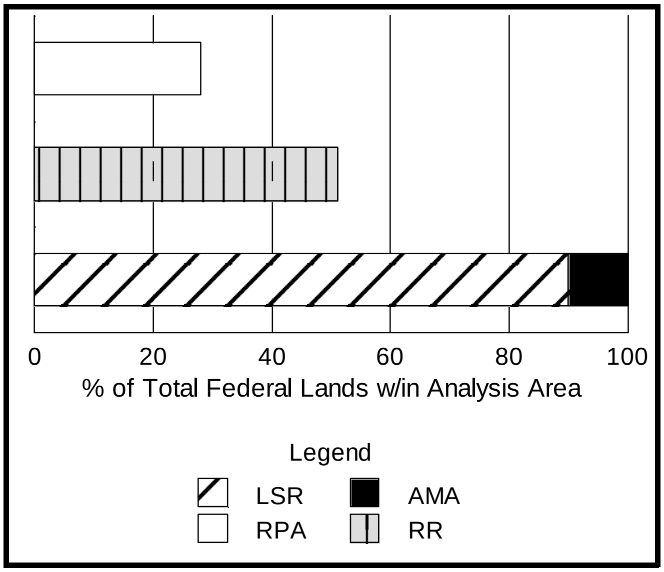

Figure I-2. Northwest Forest Plan (NFP) Land Use Allocations (LUAs) for All Federal Lands Within the Analysis Area.

LSR=Late-Successional Reserve; AMA=Adaptive Management Area; RR=Riparian Reserve; and RPA=Reserve Pair Area. RRs and RPAs can overlay each other and both can overlay LSR and AMA.

Late-Successional Reserves are managed to protect and enhance conditions of late-seral and old-growth forest ecosystems. The analysis area is within the Northern Coast Range Adaptive Management Area, one of ten identified in the region. All AMAs were designated to encourage the development and testing of silvicultural and social approaches to reaching ecological, and economic and other social objectives. In addition, the primary emphasis for management in the Northern Coast Range Adaptive Management Area is for the restoration and maintenance of late-successional forest habitat, consistent with marbled murrelet guidelines noted for this AMA in the Northwest Forest Plan (see Map 4, p. C-7).

Riparian Reserves are part of the Aquatic Conservation Strategy (ACS) and overlie all other land use allocations (see map MP-4). They include those portions of a watershed directly coupled to streams and rivers, i.e., the portions of a watershed required for maintaining the hydrologic, geomorphic, and ecological processes that directly affect standing and flowing water bodies. Riparian Reserves were also established to benefit riparian-dependent species and to retain adequate habitat conditions for dispersal of late-successional forest dependent species throughout the LSR network.

MAP 4: LAND USE ALLOCATIONS: LSR AND AMA GOES HERE

MAP 5: LAND USE ALLOCATIONS: RESERVE PAIR AREAS GOES HERE

Reserve Pair Areas provide additional habitat protection for northern spotted owls in the Northern Coast Range Adaptive Management Area (see Map 5, p. C-8). These areas identify the best 6,400 acres of habitat surrounding known owl activity centers. Limited management activities can occur in the most unsuitable areas within the RPAs.

The *Salem District Resource Management Plan* identifies two additional land use allocations: Visual Resource Management Areas (VRMAs; see Map 6, p. C-10) and Rural Interface Areas (RIAs; see Map 7, p. C-11, and also Appendix II for a brief discussion of RIAs). VRMA and RIA objectives must be considered when management activities are planned for BLM lands in the megawatershed. The megawatershed area consists primarily of VRMA Class 4 lands (23,716 acres) in which management activities may dominate the view and be the major focus of viewer attention. There are no Class 1 areas and only 573 acres of Class 2 lands, which are located near Mill Creek Park in the Mill Creek watershed. Management activities on these lands may be seen, but should not attract the attention of the casual observer. VRMA Class 3 lands, where management activities may attract attention but should not dominate the view, comprise only eight percent (2,103 acres) of the megawatershed area, primarily at the lowest elevations. VRMAs have been identified for all BLM lands in the District and the preservation of scenic quality will be considered when planning all projects in the megawatershed area.

There are 1,090 acres of BLM lands designated as RIAs. Rural Interface Areas are BLM lands within one-half mile of private residences or lands zoned for development of rural residences. Adjacent or nearby rural landowners have interests which must be considered when management activities are planned for BLM lands in the megawatershed. RIAs are found throughout the lower elevations of the megawatershed area. Most are along county and forest industrial roads in the narrow valleys which extend into the Coast Range foothills. Major RIAs in the megawatershed area are Mill Creek and Gooseneck Creeks (a small number of people live in these two drainages), and North and South Forks of Pedee Creek (a small rural population exists located mainly in the narrow valley bottoms). RIAs have been identified for all BLM lands in the District and will be considered when planning all projects in the megawatershed area.

Landscape Relationships

The analysis area lies within several larger scale hydrologic, physiographic, and management (LSRs, AMAs) landscapes (see Map 8, p. C-12). Management plans are available at some levels and not at others: some plans analyze all land types, regardless of ownership, while other plans deal specifically with only public or private lands. At the broadest scale, the Pacific Northwest Region, the Northwest Forest Plan (NFP) provides direction for all federal forest lands, and this analysis is based on standards and guidelines set forth in the NFP. The NFP identified "terrestrial ecosystems physiographic provinces," "hydrologic province planning and analysis areas," "assessments" for LSRs, and "plans" for AMAs. This analysis area falls within the Willamette Hydrologic Province Planning and Analysis Area, and the Oregon Coast Range Physiographic Province, and is covered by the *Late-Successional Reserve Assessment for Oregon's Northern Coast Range Adaptive Management Area* and the *Northern Coast Range Adaptive Management Area Guide*.

There are no comprehensive plans available currently for either the Willamette Hydrologic Province Planning and Analysis Area or the Oregon Coast Range Physiographic Province. Management

MAP 6: VISUAL RESOUCE MANAGEMENT

AREAS GOES HERE

MAP 7: RURAL INTERFACE AREAS GOES HERE

MAP 8: LANDSCAPE LEVEL RELATIONSHIPS GOES HERE

direction for the analysis area at the province level comes primarily from the standards and guide- lines found in the regional Northwest Forest Plan.

There are three LSRs, RO269 (20,534 acres), RO270 (5,953 acres), and RO807 (159,507 acres), covered in the *Late-Successional Reserve Assessment of Oregon's Northern Coast Range Adaptive Management Area* (LSRA). Most of the federal lands in the analysis area (90%, 24,431 acres) are part of RO807. The highest priority objectives of the LSRA are: 1) securing the best late-successional habitat; 2) developing corridors connecting the best habitats together; and 3) protecting the most critical fish habitat. Landscape Zones and Landscape Cells were delineated to help prioritize areas for treatment. Through the landscape design process employed by the LSRA team, the analysis area was designated as the Southern Corridor Zone. Corridor zones are intended to provide a key connectivity function to the surrounding LSR network, as well as to adjacent state and private lands. This corridor zone provides the closest federally managed land link from this landscape to LSR RO268 to the south (the Marys Peak area). Mixed Seral and Early Seral Landscape Cells were identified in the analysis area and direction is given for treatment priorities and management goals by cell type.

All AMAs were designated to encourage the development and testing of silvicultural and social approaches to reaching ecological, and economic and other social objectives. The primary emphasis for management in the Northern Coast Range Adaptive Management Area is for the restoration and maintenance of late-successional forest habitat, consistent with marbled murrelet guidelines noted for this AMA in the NFP. *The Northern Coast Range Adaptive Management Area Guide* was prepared to help the public, the scientific community, and federal land managers work together in planning and implementing AMA activities. The guide suggests working in and adjacent to late-seral stands with the hope that plants and animals will move into the younger stands as they develop late-successional/old-growth (LSOG) characteristics.

Dominant Features and Processes

Topography

The analysis area is located on the eastern slopes of the northern Oregon Coast Range Physiographic Province and has a landform of low elevation mountains which are highly dissected by steeply incised valleys. Compared with adjacent watersheds to the west and south, the topography is not as severe. To the east of the analysis area lie rolling foothills that grade out onto relatively flat agricultural lands.

The highest point in the analysis area is on the top of Laurel Mountain, with an elevation of approximately 3,675 feet. Additional significant mountain peaks in the analysis area include Monmouth Peak at 3,246 feet and Condenser Peak at 3,075 feet. The lowest elevation in the megawatershed is about 250 feet on the Willamette Valley floor.

Climate

The analysis area has a Pacific Ocean influenced climate, with cool, wet winters and warm, dry summers. There is, on average, a 15-20 °F difference between the coldest month, January, and the warmest, July. Average annual precipitation in the analysis area ranges from about 80 inches at the higher elevations to 50 inches along the eastern boundary. Generally, from 60-75 percent of the precipitation falls from November to March, primarily as rain. At higher elevations, precipitation intensities can be expected to exceed 5 inches in 24 hours roughly every two years. In 1996, Laurel Mountain, located at the northern end of the analysis area, received 204 inches of precipitation, the highest amount ever documented at any station in the state of Oregon. Snow usually remains for only a few days, except at the highest elevations, and rain-on-snow events are common. Severe winds, from 70-100+ miles per hour, can be associated with rainstorms, especially during the fall and winter.

Soils

Because they are derived from different parent materials, there are significant differences in soils and soil processes between the northern and southern halves of the megawatershed, and thus the analysis area. Volcanics, resistant to decomposition, form the parent materials in the Rowell Creek subwatershed, and in the Mill Creek and Rickreall Creek watersheds in the north half, while the Luckiamute River watershed to the south is underlain with sedimentary rock that readily decomposes. These differences can be seen in the general topography and soil characteristics: the mountains in the north have a stronger relief with shallow soils on steep hillslopes, whereas the mountains in the Luckiamute watershed have moderate to gentle slopes and deeper soils.

Soil productivity, which affects all other resources in the watershed, can be significantly impacted by soil compaction and displacement processes. Human activities, especially timber harvesting and associated road building during the 1940-1960 period, have caused an increase in the number and magnitude of soil compaction and displacement events. The Mill Creek and Rickreall Creek subwatersheds have sustained the highest loses in soil productivity. They comprise only 13 percent of the analysis area but are the site for 57 percent of all landslides in the analysis area. The potential for moderate to severe surface erosion or landslides exists on all slopes greater than 60 percent, which account for 6 percent of the analysis area. Significant improvements in road construction and timber harvesting over the last twenty years have mitigated the loss of soil productivity in the analysis area, but any increase in soil disturbing activities will increase the compaction/displacement potential.

Hydrology

It is critical to recognize that, with the exception of the Mill Creek subwatershed, public lands comprise a small portion of the analysis area, and hydrologic conditions and trends will be determined primarily by the management activities of private forest landowners. As a consequence, only data from Mill Creek were analyzed in-depth for this report. The average mean annual discharge for Mill Creek during the analysis period was estimated at 148 cubic feet per second, or about 5.1 cfs per square mile. Peak flow for Mill Creek was recorded on December 22, 1964 at 6,170 cfs or 225 cfs/mi^2. The average unit baseflow for Mill Creek in August during the analysis period was 6.2 cfs or 0.022 cfs/mi^2.

The "transient snow zone" (TSZ) for the analysis area is defined as the zone between 1,500 and 3,000 feet elevation. The TSZ is particularly vulnerable to extremes in storm events and represents an area of high risk for road construction and timber harvest. BLM manages 33 percent (in some subwatersheds up to 64%) of the land in the TSZ although only 18 percent of the lands in the analysis area are BLM lands.

Vegetation

Fire & Forest Uplands

The majority of the analysis area is dominated by coniferous forests and lies within the Western Hemlock Plant Association Zone. The conifers within this zone consist primarily of Douglas-fir, western hemlock and lesser amounts of western redcedar, and at lower elevations (500 ft.), grand fir. Red alder and big-leaf maples are common adjacent to larger-order streams. Ground cover consists mainly of salal on the ridges and dry, south-facing slopes, and sword fern on the north slopes, and mid-slopes and below where sub-surface moisture is available. Noble fir plant associations may be found on the western edges of the analysis area on peaks and ridges above 2,500 feet.

Several rock outcrops which do not support conifer growth are found primarily in the Mill Creek and Rickreall Creek drainages. These areas have shallow soils and tend to be support drought-tolerant plants such as stonecrops and poison oak.

Non-coniferous plant associations such as Oregon white oak and big-leaf maple associations are interspersed with private agricultural lands along the east and north edges of the analysis area. These lowland areas (less than 500 ft. elevation) are mostly privately-owned agricultural lands: orchards, tree plantations, pasture land, etc.

During reference conditions, high intensity, stand-replacement fires occurring at irregular intervals of 150-400 or more years (Teensma 1991) affected the megawatershed area. (See Appendix IV for a discussion of fire history in the Coast Range.) Logging has manipulated the analysis area towards the younger successional stages in which it exists today. The analysis area's forests are almost totally (96%) in the early and mid-seral (less than 80 years old) stages. Rapid response to extinguish all fires and discontinuous arrangement of fuels, due to clearcutting, slash burning and road construction, has kept most fires small. Thus, there are hundreds of small (less than 100 acres) disturbance areas throughout the analysis area.

Riparian

Riparian zones in most of the analysis area are associated with source and transport stream reaches (see "Stream Channels," p. C-16) which are characterized by streams with narrow or nonexistent flood plains, relatively steep side-slopes, and riparian vegetation similar to that of the upland conifer forest. Federal Riparian Reserves, as defined in the NFP, constitute 50 percent of the federal lands in the analysis area. Riparian Reserves can be as wide as 420 feet on both sides of a fish-bearing stream, incorporating not only the riparian zone but a significant amount of upland conifer forest, especially along source and transport reaches.

Riparian Reserve stands in the analysis area are generally lacking in LSOG forest characteristics such as large trees, diverse species, multi-layered canopies, snags, coarse woody debris, and scattered open patches. Federal Riparian Reserves and State regulated stream buffers on private and State forest lands will provide a measure of connectivity within the analysis area and to adjacent watersheds in the north, west, and south. The functionality of the connectivity is relative to the needs of the terrestrial wildlife species and the quantity and quality of the habitat at each end of the riparian corridor. Existing riparian vegetation is providing adequate shade for 77 percent of the stream miles in the analysis area. The potential for hard, coarse woody debris to enter streams is low for the entire analysis area due to the predominance of early and mid-seral forests.

Stream Channels

The analysis of channel conditions focuses on the Mill Creek subwatershed because that is where BLM lands are the most concentrated in the analysis area and where management actions have the greatest potential to affect channel conditions. There are approximately 1,487 miles of stream channel in the analysis area, of which 76 percent are "source" reaches (24% of the total are on BLM), 15 percent are "transport" reaches (9% of total on BLM), and 9 percent are "response" (4% of total on BLM) and "depositional" reaches (0% of total on BLM). While not comprehensive, field investigations to date indicate that source and transport reaches have higher sediment loads and reduced roughness, particularly coarse woody debris, relative to reference conditions. Many of the transport and source channels are aggraded and widened, probably due to an increased rate of disturbance from human-caused processes. Nearly all of the observed response and depositional channels in the analysis area are moderately to highly unstable.

Water Quality

Again, this section focuses almost exclusively on the Mill Creek subwatershed within the analysis area since this is where BLM lands are most concentrated and where management has the greatest potential to influence water quality conditions. Some water quality data was collected by the BLM on Mill Creek, while data for the rest of the megawatershed were gathered from State and other federal agencies. Current data suggest that water quality in the megawatershed is, with some notable exceptions, generally unacceptable and probably degraded from reference condition. The State lists parts of Mill Creek, Rickreall Creek, and the Luckiamute River as "water quality limited," while sections of eight streams in the megawatershed are listed as a "water body of concern." Most of the available data are connected with stream reaches below the forests of the analysis area but within the megawatershed area.

Clearcuts, logging roads, and related landslides can deliver sediments to forest streams in the analysis area, especially in landslide prone drainages like the Upper Mill Creek and Rickreall Creek subwatersheds. Some bank erosion was observed on "response" type reaches in the forested uplands of the analysis area. Stream temperatures and related dissolved oxygen concentrations can be impacted, especially in small headwater streams, by disturbance to overhead and adjacent shade producing, soil stabilizing vegetation. During 1997, stream baseflow temperatures for Mill Creek, at the lower end of the analysis area, were above basin thresholds.

There are four municipal watersheds in the megawatershed area: 1) Dallas draws surface water directly from Rickreall Creek for treatment, while the Mercer Reservoir provides regulated flow for summer diversions by the city and agricultural users; 2) Falls City draws surface water for treatment from Teal Creek and Camp Kilowan Spring; 3) the town of Sheridan withdraws water from the Yamhill River (to which Mill and Rowell creeks are tributaries); and 4) Monmouth draws surface water for treatment from Teal Creek. (see to Map MP-9.)

Species and Habitats

Plants

There are no Special Status Species (Endangered Species Act listed, proposed or candidate; BLM Sensitive or Assessment) known to occur on BLM lands in the analysis area. There are 13 Special Attention Species (SAS; *Salem District ROD/RMP*) lichens and five SAS fungi known to occur in the analysis area, along with many SAS suspected to occur in the analysis area. The analysis area contains a few plant species that are considered uncommon and of special interest. Some of these plants are protected under the Oregon Wildflower Law and are likely to occur in the analysis area, especially members of the following genera: *Calochortus, Calypso, Erythronium*, and *Rhododendron*. There are at least eight known species of noxious weeds that occur in the analysis area, all of which can be found in disturbed areas; five are widespread and while the remaining three are less common.

Special plant communities can occur in special habitats such as wet and dry meadows, wetlands, talus slopes, and grassy balds within the general forest environment. These unique areas are usually the expression of geomorphological processes that are very persistent on the landscape. In addition to the many small special habitats scattered throughout the megawatershed area, there is one special botanical area designated in the megawatershed, Forest Peak ACEC/RNA, and there are three special botanical areas designated in the analysis area: Little Grass Mountain ACEC/ONA, Little Sink ACEC/RNA, and Rickreall Ridge ACEC.

Fish

The only federally listed species in the megawatershed area is the endangered Oregon chub, which is extirpated from the area but was recorded to have occurred in the lower reaches of the Little Luckiamute River. The closest known site in the Willamette basin for the small minnow is within the Finley Wildlife Refuge, more than fifteen miles to the south of the Luckiamute watershed. Two species known to occur in the megawatershed are proposed for federal listing as threatened: spring chinook salmon and winter steelhead trout. Native Oregon Coast Range cutthroat trout are currently State listed as a stock of concern.

Public lands in the analysis area provide relatively few miles of resident fish habitat, 57.9, and very little anadromous fish habitat, only 1.7 miles. Human activities in the analysis area, especially timber harvest and road construction, have had a cumulative negative impact on fish habitat. Among the most significant impacts are the lack of coarse woody debris in streams, increased soil movement, barriers to fish migration, and the loss of conifers in the riparian zone. Five of the seven subwatersheds in the analysis area were surveyed for condition of streambed substrates, abundance of coarse woody debris in the stream channel, and area and quality of pools at baseflows. Many of the stream reaches surveyed were lacking in an adequate number of functional pools, structural complexity in the stream channel, and structure in existing pools.

Wildlife

Special Status Species (SSS) are species of concern because their populations are considered to be the most unstable over all, or part, of their range, due primarily to modification or loss of their preferred nesting and/or foraging habitats. In some cases, the concern is due to a complete, or almost complete, lack of knowledge concerning the species' ecology, current conditions, or trends. The following terrestrial invertebrate and vertebrate taxa are considered to be SSS in the analysis area:

Earthworms: 1 species
Snails: 1 species
Slugs: 2 species
Amphibians: 13 species
Reptiles: 1 species
Birds: 4 species
Mammals: 7 species

Big game species are considered priority species (*Salem District ROD/RMP*) because the conditions and trends of their populations are considered to be socially and economically important to many Oregonians. Black bear, black-tailed deer, Roosevelt elk, and cougar are all present in the analysis area.

Wildlife habitat is described and analyzed using landscape ecology terms and processes, and forest plant association successional or seral stages. Landscape patterns are commonly defined by the presence of the following three elements: matrix (not to be confused with NFP Matrix, or timber harvest areas), patches, and corridors. Under current land ownership and usage conditions, the landscape has lost its historic late-seral/old-growth matrix component and is now highly fragmented by a conglomeration of early and mid-seral patches representing a wide range of size and age classes. The corridor elements of streams, riparian zones, and roads provide some limited connectivity between patches (a functioning matrix would provide significant connectivity). Special Habitats such as wet and dry meadows, wetlands, and grassy balds are scattered throughout the area. There are no known significant caves, cliffs or talus slopes in the analysis area. Special Habitat Components such as large snags and coarse woody debris have been greatly reduced over the last century throughout the analysis area.

Human Uses

Timber harvesting has been, and continues to be, the major human use in the analysis area: within the last 95 years, billions of board feet of timber have been removed. Clearcutting on private and State lands occurs in the mid-seral (40-79 years) age class, usually followed by burning and replanting. On federal lands, the newly placed emphasis on the maintenance of habitat for both terrestrial and aquatic late-seral/old-growth dependent species has abruptly shifted management objectives away from timber production. Density management (selective thinning, patch cuts, etc.) in early and mid-seral stands will be used where appropriate to accelerate the attainment of late-seral/old-growth forest characteristics on BLM and US Forest Service lands. Federal lands will continue to provide opportunities to manage for multiple commodities, especially in the AMA; however, the amounts may be significantly reduced from past levels.

As logging roads opened up the area, a number of minor uses have developed over time. The harvesting of special forest products such as firewood, salal, mushrooms, moss, and edibles and medicinals occurs throughout the analysis area. Hunting, primarily deer and elk, and fishing are the major recreational activities.

Chapter II: Issues & Key Questions

Introduction

This chapter includes the specific issues that were identified as relevant to the megawatershed and the analysis area, and the key questions developed from these issues. Key questions focus the analysis on particular types and locations of cause-and-effect relationships, and help describe conditions as they relate to values, uses, and important ecosystem components and processes within the megawatershed.

A variety of sources provided insight into the values and uses which led to the issues identified for this watershed analysis. They include recent analysis documents such as the Northwest Forest Plan, on a regional level, and the *Late-Successional Reserve Assessment for Oregon's Northern Coast Range Adaptive Management Area*, on a province level. Interactions with landowners, watershed councils, and other interested individuals and groups, and discussions with county officials and federal resource specialists also helped to identify issues and key questions.

Land Tenure

Issues

Meeting the objective of late seral/old growth (LSOG) ecosystem management on BLM-administered lands may be difficult to achieve in this analysis area because the lands are scattered or occur in a checkerboard pattern with private lands. Additionally, in all but the Mill Creek watershed, BLM lands constitute a very small percentage of the lands in each watershed.

There are few acres of Land Tenure Zone 3 lands within the megawatershed; therefore, lands in other watersheds may have to be considered for exchange to help block-up lands within the megawatershed.

Matrix-designated lands within the Salem District can be exchanged only for other Matrix lands and not for lands within the LSR and AMA designations. This may limit the ability to block-up lands within the LSR and AMA.

Key Questions

- How many acres of Land Tenure Zone 1, 2, and 3 lands (*Salem District ROD/RMP*) are there in the megawatershed?

- Should any BLM lands in the megawatershed be blocked-up to facilitate meeting the goals and objectives of the Northwest Forest Plan, the Salem RMP, the *Late-Successional Reserve Assessment for Oregon's Northern Coast Range Adaptive Management Area* and the *Northern Coast Range Adaptive Management Area Guide*? If so, which BLM tracts should be given up in exchange for private lands adjacent to BLM lands, and which tracts should be blocked-up?

- Should any isolated or scattered BLM LSOG stands within the megawatershed be identified as refugia for LSOG-dependent species? If so, how long would they function as refugia? Should short- and long-term goals be set for these isolated stands since they may not function as refugia indefinitely?

- If BLM lands outside the megawatershed will be needed as exchange parcels to block-up BLM lands within the megawatershed, how will the decision-making process work?

Soils

Issue

Road construction and past timber harvest activities have resulted in a loss of soil productivity beyond natural levels. Soil compaction and displacement, and erosion processes (surface erosion and mass wasting) have increased in parts of the analysis area, and these activities have, on occasion, adversely impacted water quality and/or aquatic species' habitat.

Key Questions

- What were the historical patterns of soil compaction and displacement, and erosion processes as related to soil productivity?

- What are the current conditions of soil productivity as related to compaction, displacement, and erosion processes?

- What are the natural and human causes of changes between historical and current conditions of soil productivity?

- What are the opportunities to manage soil resources in order to maintain or enhance desired future conditions?

- What are the influences and relationships between compaction, displacement, and erosion processes and other ecosystem processes and components (e.g., vegetation, coarse woody debris recruitment)?

Hydrology

Issues

Modifications of hill-slopes and riparian areas due to road construction and timber harvest have altered the timing, duration and quantity of stream flows in the analysis area.

Key Questions

- What were the historical hydrological characteristics (total discharge, peak flows, minimum flows) and features (cold water seeps, ground water recharge areas) in the analysis area?

- What are the current conditions and trends of the dominant hydrologic characteristics and features in the analysis area?

- What are the natural and human causes of change between historic and current hydrologic conditions?

- What are the influences and relationships between hydrologic processes and other ecosystem processes (e.g. sediment delivery, fish migration)?

- What are the opportunities to manage hydrologic characteristics in order to meet Aquatic Conservation Strategy objectives?

Vegetation

Fire & Forest Upland Issues

Ecological succession, coupled with human-caused and natural disturbances, has created a mosaic of vegetation types which is quite different from vegetation patterns of the past. Although vegetation patterns are never static, the rate and intensity with which these patterns change can be greatly affected by management activities.

The boundaries of special botanical areas, Areas of Critical and Environmental Concern (ACECs), may not be adequate to provide protection to the primary values for which the individual ACECs were established.

Fire & Forest Upland Key Questions

- What was the historical and landscape pattern of plant communities and seral stages? What processes caused these patterns?

- What are the current conditions and trends of plant communities and seral stages in the analysis area? What activities and processes (e.g., recreation, noxious weeds, logging) threaten the biological integrity of sensitive botanical areas (ACECs)?

- What are the natural and human causes of change between historical and current vegetative conditions? What are the influences and relationships between vegetation and seral patterns and other ecosystem processes (e.g., hydrologic maturity, channel stability)?

- What are the opportunities to maintain or enhance vegetation under the guidance of the NFP?

Riparian Reserve Issues

Riparian area modifications such as road construction, physical alteration of stream channels, and removal of riparian vegetation have changed species composition and decreased structural diversity. This has resulted in altered habitat for riparian associated species. Many riparian areas are deficient in large conifers that are future sources of coarse woody debris, and young plantations do not provide adequate streamside shade. Late-seral connectivity between watersheds has been decreased.

Riparian Reserve Key Questions

- What were the historical landscape patterns of riparian ecosystems in the analysis area?

- What are the current conditions and trends that affect riparian ecosystems within the analysis area?

- C What are the criteria and/or conditions for determining various management actions or restoration projects within Riparian Reserves, given the guidance in the Northwest Forest Plan?

Stream Channels

Issues

Alterations in stream channel morphology and function have occurred. Causes of these alterations may have included modifications of the stream flow regime, changes in sediment delivery, removal of riparian vegetation, and/or alteration of coarse woody debris and complex structure on the floodplain and in the channel. Some channels may have been altered by installation of bridges and culverts or by the operation of heavy equipment in or adjacent to the channels.

Key Questions

- C What were the historical morphological characteristics of stream valleys and general sediment transport and deposition processes?

- C What are the current conditions and trends of stream channel and sediment transport and deposition processes prevalent in the analysis area?

- C What are the natural and human causes of change between historical and current channel conditions?

- C What are the influences and relationships between channel conditions and other ecosystem processes (e.g., in-channel habitat for fish and other aquatic species, water quality)?

- C What are the opportunities to manage BLM lands in the analysis area in order to meet Aquatic Conservation Strategy objectives for stream channels?

Water Quality

Issue

Alteration of watershed hydrology and stream channels from reference conditions has resulted in degradation of water quality.

Key Questions

- C What were the historical water quality characteristics of the analysis area?

- C What beneficial uses dependent on aquatic resources occur within the analysis area ? Which water quality parameters (e.g., pH, DO) are critical to these uses?

- C What are the current conditions and trends of beneficial uses and associated water quality parameters?

- C What are the natural and human causes of change between historical and current water quality conditions? What are the influences and relationships between water quality and other ecosystem processes?

- What are the opportunities to manage BLM lands in the analysis area in order to meet Aquatic Conservation objectives for water quality?

Species & Habitats

Plant Issues

Species of concern must be considered when federal action is taken that may affect these species or the habitats on which they depend.

Several non-native plant species have been introduced to this ecosystem, and as a result, some native plant communities are now declining.

Plant Key Questions

- What are the current distribution and relative abundance of species of concern and their habitats?

- What are the distribution and relative abundance of noxious weed species?

Fish Issues

Habitat for resident and non-resident fish and other aquatic species has been degraded and/or is declining in condition in the analysis area. Habitat problems causing the degradation and/or decline include a lack of coarse woody debris, quality pools, complex systems of side channels, and proper substrates.

Fish Key Questions

- What were the historical relative abundance and distribution of species of concern and the condition and distribution of their habitats?

- What are the relative abundance and distribution of species of concern that are important in the analysis area? What are the distribution and character of their habitats?

- What are the natural and human causes of change between historical and current species distribution and habitat quality for species of concern? What are the influences and relationships of species and their habitats with other ecosystem processes?

- What are the opportunities to manage habitats in order to maintain or enhance desired future conditions?

Wildlife Issues

The forest landscape pattern has changed in shape, size, and age from a late-seral/old-growth matrix to an early/mid-seral matrix. Timber harvesting has fragmented the forest landscape, creating a greater density of patches which are smaller in size than those created under the natural disturbance regime of large-scale forest fires.

The natural disturbance regimes of fire and wind left large amounts of several Special Habitat Components (snags, coarse down woody debris, and large live remnant trees) throughout all seral stages in both the riparian zones and forest uplands, while human activities during the last 150 years have cleaned the forest of these Special Habitat Components.

Special Habitats such as caves, cliffs and wetlands are unique and important breeding and foraging areas for a number of wildlife species.

Species of concern must be considered when any federal action is taken which may affect the species or the habitat upon which they depend (Endangered Species Act, BLM Manual 6840, *Northwest Forest Plan*, *Salem District ROD/RMP*).

The welfare and management of big game species are a social and economic concern to many Oregonians.

Wildlife Key Questions

- Is the analysis area deficient in late-seral/old-growth forest habitat?

- How have changes from the natural range of conditions in the landscape pattern of seral stages affected composition, origin, stability, contrast, edge, grain, patch shape and size, connectivity, porosity, and patchiness?

- What ecological roles do federal and non-federal lands play in the analysis area?

- How have changes from the natural range of conditions in the landscape pattern of seral stages affected Special Habitat Component levels and recruitment?

- What are the contributions of Special Habitats to biodiversity and ecological function in the analysis area?

- What is the existing distribution of species of concern and their habitat in the analysis area; how should these habitats be managed?

- What are the species for which there are social goals, and what is the current condition of the species relative to these goals?

Human Uses

Commodity Forest Product Issues

New management approaches to achieve the restoration and maintenance of aquatic resources and the promotion of late-successional forest habitat may not provide the "economic and social benefits to local communities" called for in the Northwest Forest Plan.

Revenue producing density management projects will be limited because of the restrictions imposed in LSRs, RRs, etc.; non-revenue producing density management projects may be limited due to the lack of ability to fund them through sources other than timber sales.

Density management projects will need to be prioritized to determine when and where they will occur.

Commodity Forest Product Key Questions

- What were the historical patterns of forest product use?

- What level of harvest for forested acres (especially timber) and special forest products can be sustained for the next 10-20 years without impacting negatively the objectives set for those land use allocations (e.g., LSRs, RRs) in which commodity production is not a primary objective?

- What differences will there be in how LSR versus AMA lands will be managed for commodity production?

- What criteria would be used to determine when and where density management projects would occur and will there be alternative ways of funding density management projects by (1) modifying "traditional" timber sale contracts (to produce funding for non-revenue generating projects) and/or (2) finding supplemental funding (outside of timber sale revenues)?

Transportation Management Issues

To facilitate timber harvest, extensive road systems were developed throughout the analysis area, but early construction standards for roads and bridges have left legacies that in some cases contribute to adverse environmental conditions.

Reciprocal rights-of way agreements with industrial forest landowners limit BLM road-closure opportunities on the majority of existing roads.

Transportation Management Key Questions

- What were the historical transportation patterns?

- What are the current conditions of the transportation system?

- Will the existing conditions of roads in the analysis area meet future demands on the transportation system?

Recreation Issues

Forest roads constructed for management activities serve the recreating public by providing access for hunting, fishing, collecting special forest products, pleasure driving and access to trailheads for motorcycles and mountain bikes. Some recreational uses may result in conflicts with other resources, between different types of recreation users, and between recreationists and local landowners.

Recreation Key Questions

- What are the major recreational resources and uses and where do they occur within the analysis area?

- What are the current conditions and trends of recreational resources and uses?

- What are the influences and relationships between recreation resources and uses and other ecosystem processes in the analysis area?

CHAPTER III: REFERENCE & CURRENT CONDITIONS

INTRODUCTION

The current conditions of climate and forest plant associations in the Pacific Northwest stabilized around 6,000 to 10,000 years ago during the Holocene Epoch (also called the Recent or Post-Glacial Epoch, i.e., the period in which we are currently living). The term "**Reference Conditions**" refers to the time period from stabilization of the Western Hemlock Zone plant association to 1850 (prior to Euro-American settlement). Reference Conditions include the presence, activities, and impacts of Native American Indians living in the megawatershed area prior to Euro-American settlement.

The term "**Current Conditions**" refers to the time period from 1850, or settlement by Euro-Americans, to the present. This time period includes the significant cumulative events which are responsible for the present state of our forest resources.

LAND TENURE: Reference Conditions

The upland conifer forests of the Oregon Coast Range were unencumbered during reference conditions. Native Americans who lived along the Oregon Coast, the lower Columbia River, and the Willamette Valley were so successful at fishing, hunting, and gathering in these areas that they spent little time, and had no permanent dwellings, in the upland conifer forests of the Coast Range.

LAND TENURE: Current Conditions

Over the last century, the forests of the Oregon Coast Range have been claimed by private, corporate, county, state, and federal landowners. Today in the analysis area, there are four major and five 'minor' landowners, plus numerous small to medium parcels in different private ownerships (the category 'other' covers these smaller private ownerships [see Map 3, p. C-4]). The majority of land, 80 percent (113,437 ac.), is owned by private timber companies. The BLM manages 18 percent (25,956 ac.) of the remaining forests, while the State and the U.S. Forest Service each control about one percent.

The *Salem District ROD/RMP* defines Land Tenure Zones 1, 2 and 3 as guides in the selection of BLM lands for exchange, sale, transfer, or acquisition. Within the analysis area, there are *no* (0 acres) Zone 1 lands, 25,741 acres of Zone 2 lands, and 215 acres of Zone 3 lands. Land Tenure Zone 1 contains BLM lands that are the least fragmented by existing ownership patterns, and therefore cannot be sold and should not be transferred or exchanged. Zone 1 areas also have the highest priority for acquisition and blocking-up to increase stand sizes. Lands in Zone 2 are typically checkerboard lands and cannot be sold, but they can be exchanged or transferred. They are second in priority for blocking-up to increase stand sizes. Lands in Zone 3 are the most scattered and isolated in the District; these parcels can be sold, transferred or exchanged.

SOILS: Reference Conditions

The analysis area contains subwatersheds with varying parent materials, relief and climatic inputs, resulting in a variety of geomorphic landforms. In the northern part of the analysis area, there are about 18,457 acres of BLM lands in the Mill, Rickreall and Rowell Creek subwatersheds. This area contains uplifted geologic formations that are resistant to decomposition. This has resulted in the area having strong relief with shallow soils on steep hill-slopes. About 7 percent (1,350 acres) of this BLM land has steeply sloping soils adjacent to streams. About 30 percent (5,378 acres) of the BLM area consists of soils that are shallow and very gravelly (droughty). In addition, about 200 acres of rock outcrops, grassy balds and brush land are found in these subwatersheds on BLM land. The remainder of the analysis area is underlain by sedimentary rock that readily decomposes, resulting in subwatersheds with moderate to gentle slopes and deeper soils.

Soil productivity in the analysis area was largely determined by levels of soil organic matter and soil nitrogen; availability of trace minerals was also important. Soils on steep slopes and ridge tops (>1,750 feet) had lower organic matter levels than at lower elevations. This was due to erosion rates exceeding rates of soil formation and/or deposition, less available water for plant growth, and possibly, a higher frequency of fire. Soil nitrogen levels were maintained by additions through precipitation, nitrogen-fixing plants, and decomposition of dead plant material and soil organic matter. Soil nitrogen levels likely declined following severe fires, if they occurred at intervals of less than 90 years, when there was complete removal of trees, ground cover and duff.

Except for a few trails from humans and animals, the amount of soil compaction prior to 1850 is assumed to be minimal.

Soil displacement on a given site, or loss of soil from a given site, occurred as a result of windthrow, landslides, and surface erosion, influenced by climatic conditions such as heavy rainfalls and other factors. The rate of surface erosion and debris avalanches would most likely have been higher for a period of several decades in areas where intense fire activity had eliminated most of the vegetation. The degree of soil displacement and soil loss varied across a site, being influenced by wind exposure, type and size of vegetative cover, presence or absence of root disease, degree of slope, depth and type of soil, angle of underlying bedrock, etc.

Erosional processes that occurred prior to 1850 are assumed to be the same as those that occur today. Watershed hill-slopes intercepted water and routed it to channels. Watershed health was directly related to the condition of the soil and associated vegetation on these slopes, and affected the input of soil and water to the streams. Natural hill-slope erosion processes affected the delivery of soil sediments and water to streams. Prior to 1850, soils in the analysis area probably varied in their characteristics, behavior, and productive capacity just as they do today. This variation was primarily due to differential resistance to weathering of soil parent materials, which influences slope gradients and shapes, and for a given climatic zone, has the greatest impact on soil types.

Data on the intensity and timing of landsliding prior to 1850 are absent. We may infer from current data that the overall intensity and rate of landsliding were probably less than we see today (erosional *processes* were the same prior to 1850 as they are today). Prior to 1850, the rate of landsliding in areas experiencing severe fires or windthrow events would be similar to that measured today in areas where root strength has been severely reduced by fires or clear-cut harvesting.

In the past as in the present, surface erosion would be primarily influenced by amounts of vegetation and debris present on a given site, percentage of slope angle, soil porosity and soil surface condition as it relates to infiltration rate. Surface erosion is also influenced by soil water storage capacity (affects how quickly the soil profile saturates) and number of freezing-thawing and wetting-drying cycles in a given time period (affects rate of dry ravel). Prior to 1850, frequent, low intensity fires conducted by native peoples in the valley and foothill areas probably had a minimal effect on surface erosion rates in those locations. (See Appendix IV for a discussion of fire history in the Coast Range.) Grasses and forbs, the primary vegetation, recover quickly following a low intensity fire. The soil surface would have been well protected by the time winter rains set in. Topography in these Willamette Valley fringe areas was gentle, so dry ravel was not a factor and surface runoff rates were slow. Undoubtedly there were times when intentionally set or natural fires escaped into steeper areas of the analysis area and likely resulted in intense fires. In areas where most of the trees and shrubs were killed, rates of shallow landslides would have increased as roots deteriorated (over a period of approximately 20 years) following the disturbance. Significant increases in surface erosion likely occurred for a period of several years following intense fire. As vegetation re-established and stabilized a given site, rates of surface erosion and shallow landslides would return to pre-disturbance levels. (See Appendix III for a more detailed discussion of erosional processes.)

The primary factors affecting soil erosion and compaction/displacement in the analysis area prior to 1850 are as follows:

- Hill-slopes with slope gradients greater than 60 percent are subject to high erosion rates from surface erosion and mass wasting (Swanston and Grant 1982). Studies show a close relationship between hill-slope gradient and soil surface erosion. Some 1,476 acres of BLM land in the analysis area have slope gradients in excess of 60 percent. In this analysis area, high sediment yields probably existed in the northern part, similar to the conditions for the adjacent Upper Siletz Watershed.

- In the southern portion of the analysis area, surface soils generally contain 50-70 percent silt and clay-sized particles. Once suspended in water, they settle out slowly, so tend to be carried out of the watershed during high flows. Due to the high percentage of very small, colloidal-sized particles, release of soil colloids to streams occurs year around and gives a “milky” appearance to stream water. In contrast, sediment size in northern portions of the analysis area is characterized by higher levels of coarse fragments.

- Precipitation in the analysis area provides for high plant biomass production and rapid regrowth after low intensity fires and other natural events. Surface soils were thus protected by vegetation fairly continuously over long periods of time.

SOILS: Current Conditions

Soils in the analysis area have been impacted by cultural activities associated with settlement and resource extraction which began around 1850 and continue to this day. The following activities have reduced soil productivity:

- Soil compaction and/or displacement have resulted from timber harvesting by ground-based yarding equipment, mechanical site preparation (scarification and brush piling) and slash burning. The most serious productivity losses from compaction occur on the most productive lands where timber management activity is concentrated. Most logging in the analysis area occurred between 1940 and

1960; the majority of the yarding was ground-based, utilizing crawler tractors. As a result, extensive areas have soils that are disturbed, displaced and compacted. Considerable displaced soil material and logging debris was, and some still is, available to enter streams. Organic matter losses from soil displacement and slash burning occur on shallow and moderately deep soils. Any activity that reduces organic materials on these soils will result in a reduction of soil nutrient levels.

- Accelerated soil erosion from surface disturbing activities: Surface disturbance from timber harvest, site preparation, burning, and road construction has increased soil erosion by water transport, dry raveling and debris avalanche landslide. On shallow soil areas, mature forest cover that existed before logging has been mostly replaced by brush, due to the difficulty of re-establishing trees on these sites. Brush offers less moderating effects on soil temperatures, resulting in greater soil climatic variation (wetting-drying and freeze-thaw) which increases rates of soil loosening, resulting in dry ravel on steep slopes. Dry ravel and water transported surface erosion strongly impact very shallow soils, often exposing rock. Accelerated soil movement into headwall areas shortens the return rate of debris avalanche landslides originating from them. Much of the eroded material is eventually deposited in streams.

Landslide numbers from Table III-1 (p. R&CC-5) were determined from counts taken off aerial photograph sequences for the years shown. The numbers presented should only be used as estimates due to limitations of photographic inventories. These numbers, however, do represent minimum numbers of landslides for the respective time periods.

The following conclusions can be drawn from the landslide data given in Table III-1:

- About 57 percent of all landslides occurred in the Rickreall and Mill Creek subwatersheds. These subwatersheds make up approximately 13 percent of the analysis area. Slide rates were about one slide per 494 acres overall, but one slide per 23 acres of land having greater than 60 percent slope gradients.

- The ratio of road-related landslides vs. landslides originating from forested areas is about 7.7:1, and the ratio of landslides from clear-cut areas vs. those from forested areas is about 7.2:1. These ratios are similar to those measured in similar areas of adjacent watersheds.

- About 80 percent of all slides originated from private lands, and private lands comprise about 80 percent of the analysis area. No slides originated off BLM roads during the 1996 peak storm event.

Table III-1. Number and Type of Landslides Impacting Streams and Hillslopes

	Landslide Causes						
	Road Related		Clear-cut Related		Forested		
Aerial Flight Year	Private	Public	Private	Public	Private	Public	Total
1956	50	12	24	12	3	2	103
1966	26	1	17	1	2	1	48
1974	5	6	6	6	0	0	23
1982	4	3	0	0	0	0	7
1996	33	0	52	12	8	2	107
Totals	118	22	99	31	13	5	288

See Map MP-2 for locations of slide origins and slide tracks.

! About 56 percent of the slides occurred before 1956, when there was considerable logging activity. About 37 percent of the slides occurring during the 1996 peak storm event originated from roads and recently logged areas. High levels of road failures found on the 1956 photos probably resulted from inadequate engineering of road locations, side-cast construction and inadequate culvert size and spacing. High levels of landslides in clear-cuts found on the 1996 photos occurred primarily in recently relogged areas, located mostly in lower Luckiamute, Little Luckiamute and Rickreall creeks. Most occurred from headwalls, cable yarding tracts on convex slopes or from slump earth flows in unstable areas.

! Most landslides originate on slopes with gradients in excess of 60 percent, at the head of the drainage, or at creek crossings on mid-slope roads. Most slides stopped at the first stream junction below the failure, unless the slide volume was very large. Landslide tracks that traveled long distances occurred in high gradient streams where large volumes of moving material entered the stream channel at very low angles.

During the 1940s and 50s, large areas were logged using crawler tractors. This required close access road spacing and closely spaced (about 100 feet apart) skid roads. Access and skid roads were often placed in or along side drainages and on steep hillsides. Impacts to soil productivity from compaction and displacement was high. In some areas, much of the streamside vegetation was damaged or removed as well, resulting in significant quantities of soil entering stream channels directly or in runoff. Since that time, hill-slopes and riparian zones have revegetated. It is likely that considerable amounts of sediment generated from logging still remain in the stream system, and portions of this sediment move through the system whenever there are high stream flows. One study suggested a residence time for fine sediments in first-order mountain streams to be 19 years and considerably longer in higher order streams (Dietrich and Dunne 1978). It is likely that part of the turbidity present in streams during high flows is attributable to movement of these "old" sediment deposits originating from past logging activities.

About 894 acres of BLM lands in the analysis area have been yarded by ground-based equipment during the past 40 years. Dyrness and Swanston (1973) reported that about 35 percent bare soil and 26 percent compacted soils are typical for areas yarded by ground-based equipment. Since the 1970s, operating restrictions on steeper terrain have greatly reduced usage of ground-based equipment on BLM lands. Beginning around 1980, most of the soil compaction in new harvest areas has been mitigated so that less than 12 percent of the harvest area is compacted.

Skid roads and many old access roads are unsurfaced. OHV and motorcycle use is active in this analysis area and is concentrated on these old "dirt" roads. This activity has prevented many of the old roads from revegetating and they are a chronic source of sediment to streams.

A summary of the primary factors affecting soil erosion and compaction/displacement in this analysis area from 1850 to the present are as follows:

- Railroad and steam donkey logging had little long-term impact on soil erosion and caused minor amounts of localized soil displacement and compaction.

- From 1940 to 1960, tractor yarding occurred on many steep and moderate slopes, resulting in deep gouges on some hillsides. Some yarding occurred in and adjacent to first- and second-order streams. These actions resulted in accelerated erosion of fine sediments into streams. Much of the material moved through the system quickly, but a significant amount of sediment remains trapped behind logging debris and vegetation in the channels and flood plains. During bank-full and higher events, some of this material is moved further through the system, resulting in high turbidity. In some locations, vegetation has stabilized the old deposits.

- Approximately 313 acres of BLM land in the analysis area have compacted soils from past logging activities. Detrimental effects from compaction can last in excess of 50 years (Power 1974), with total volume yield reductions of up to 40 percent on the compacted areas.

HYDROLOGY: Reference Conditions

Hydrologic processes during the Holocene are assumed to have been the same as those currently observed. Streamflow in the analysis area likely varied in this period with short-term (1-99 years) to long-term (100+ years) climatic patterns in interaction with natural disturbance regimes such as fire, rain, windstorms, disease, and earthquakes.

Drier climatic periods likely resulted in a tendency towards reduced peak flows, flooding, and summer base flows (due to reduced levels of water storage). These conditions may have been partially offset by increases in the frequency and/or the intensity of wildfires in response to drought conditions. Wildfires, which dictated the primary patterns of disturbance in forested regions, burned the hillslope vegetation and set the stage for major erosion events (mass wasting and surface erosion) and altered the baseline hydrologic conditions.

Following these fires, the large reductions in plant biomass, along with concomitant reductions in evapotranspiration, which resulted may have helped moderate the reduction of summer base flows. Reductions in surface infiltration may have resulted from baked soil surfaces, producing earlier and larger peak flow events. Simultaneously, while the stage was set for increases in sediment production and delivery to streams through mass wasting and surface erosion, these were likely offset by reductions in the size and frequency of storm events which precipitated mass wasting and provided the stream energy to transport the eroded material.

During wetter periods, the situation was reversed: higher precipitation resulted in a tendency towards higher base flows, peak flow events and flooding. However, these tendencies may have been partially offset by the accompanying reductions in wildfire and its disturbance effects.

HYDROLOGY: Current Conditions

Conclusions concerning hydrologic effects of historic management are hypothetical and are based on professional estimate, deduction, and extrapolation. Overall, the material in this section is adequate for broad planning purposes. Site-specific data and recommendations are necessary to apply conclusions from this section to specific projects.

Stream discharge has been measured at several gauging sites in the analysis area, including Mill Creek, Rickreall Creek, South Yamhill River and the Luckiamute River. This analysis focuses on gauging data at the Mill Creek site where stream flow data was collected (at river mile 11.5) from 1958 to 1973 for a 27.4 square mile (mi^2) portion of the Mill Creek drainage. The average mean annual discharge for Mill Creek during this period was estimated at 148 cubic feet per second (cfs), or approximately 5.1 cfs/mi^2. Figure III-1 (p. R&CC-8) displays this statistic for Mill Creek and other Coast Range watersheds.

Figure III-1 displays an obvious peak in concentration of stream discharge around the Siletz River, Rickreall and Mill Creek watersheds. This is likely a response to the higher average precipitation in this region of the Coast Range relative to other areas and implies higher rates of hydrologic processes, such as sediment transport.

Typical of western Oregon, over 50 percent of the annual flow at the Mill Creek gauge came in the months of November though February. Monthly mean flows ranged from a low of about 40 cfs, occurring in late summer, to a high of 376 cfs during typical winter months. Maximum monthly flows generally occurred during the months of December, January, and February.

Significant flood events have occurred historically on a fairly regular basis throughout western Oregon (Bodhaine & Thomas 1964). The Mill Creek river gauge recorded several events between 1958 and

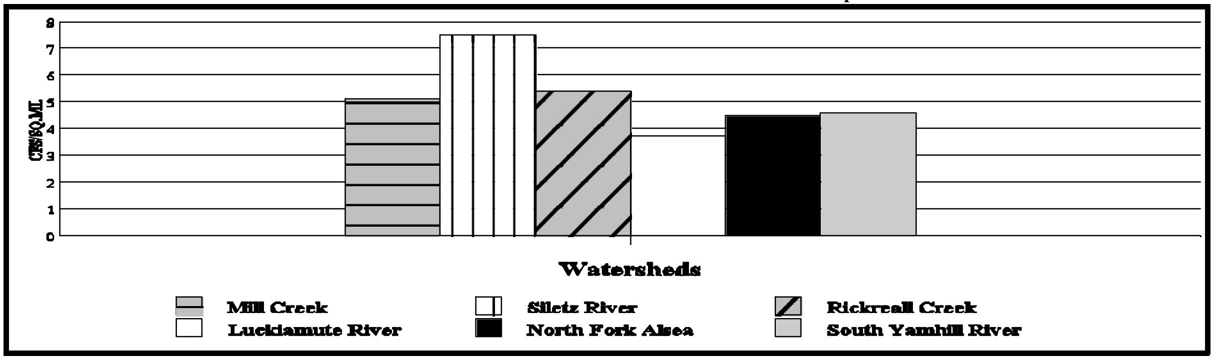

Figure III-1. Mean Annual Discharge in Cubic Feet per Second per Square Mile (cfs/mi^2) for Selected Gauge Sites in the Oregon Coast Range

1973, with the largest (on 12/22/1964) having a peak discharge of 6,170 cfs, or 225 cfs/mi^2. For comparison, the same event resulted in a peak discharge of 315 cfs/mi^2 on the Chetco River near Brookings, 224 cfs/mi^2 on the North Fork Alsea River, and for the Muddy Creek watershed near Corvallis, the figure was 56 cfs/mi^2.

Figure III-2 (p. R&CC-9) displays the unit peak flow (instantaneous peak flow for a ten-year event per unit area) for Mill Creek in comparison to the unit peak flow in selected Coast Range watersheds and other regions of the Pacific Northwest (Frissell and Nawa 1992).

Unit peak flow is proportional to storm intensity and can be viewed as a ratio that compares the response of watersheds across regions. Unit peak flow in Mill Creek, 1.61, is 15 percent higher than the regional mean of 1.4. Watersheds in the North Coast Range are second only to the Klamath Mountains of southwest Oregon and northwest California, a region notorious for the intensity of its peak flow events. Unit peak flow has been correlated with stream channel instability and failure rates of fish habitat enhancement projects (Frissell and Nawa 1992).

Mill Creek flood events are similar to other documented floods in the region. These peak flow events occur during the rainy season, following a rapid and substantial depletion of the snowpack during a prolonged rain-on-snow period in the "transient snow zone" (TSZ), which is estimated to occur between 1,500 and 3,000 feet in elevation. Below this elevation range, precipitation is predominantly rainfall. Approximately 32 percent (45,412 acres) of the analysis area lies within the TSZ; of this area, the BLM manages 33 percent (14,631 acres) of the total. This is a comparatively large concentration of BLM-managed lands in the TSZ since the BLM manages only 18 percent of the analysis area.

Figure III-3 (p. R&CC-10) displays the proportion of each subwatershed in the TSZ, snow dominant zone (>3,000 feet), and rain dominated zones. Upper Rickreall, Mill Creek, and the Upper Luckiamute all have over 33 percent of their land base in the TSZ. Since BLM management is concentrated in the higher elevations of these subwatersheds, 10,700 acres of BLM land (64 percent

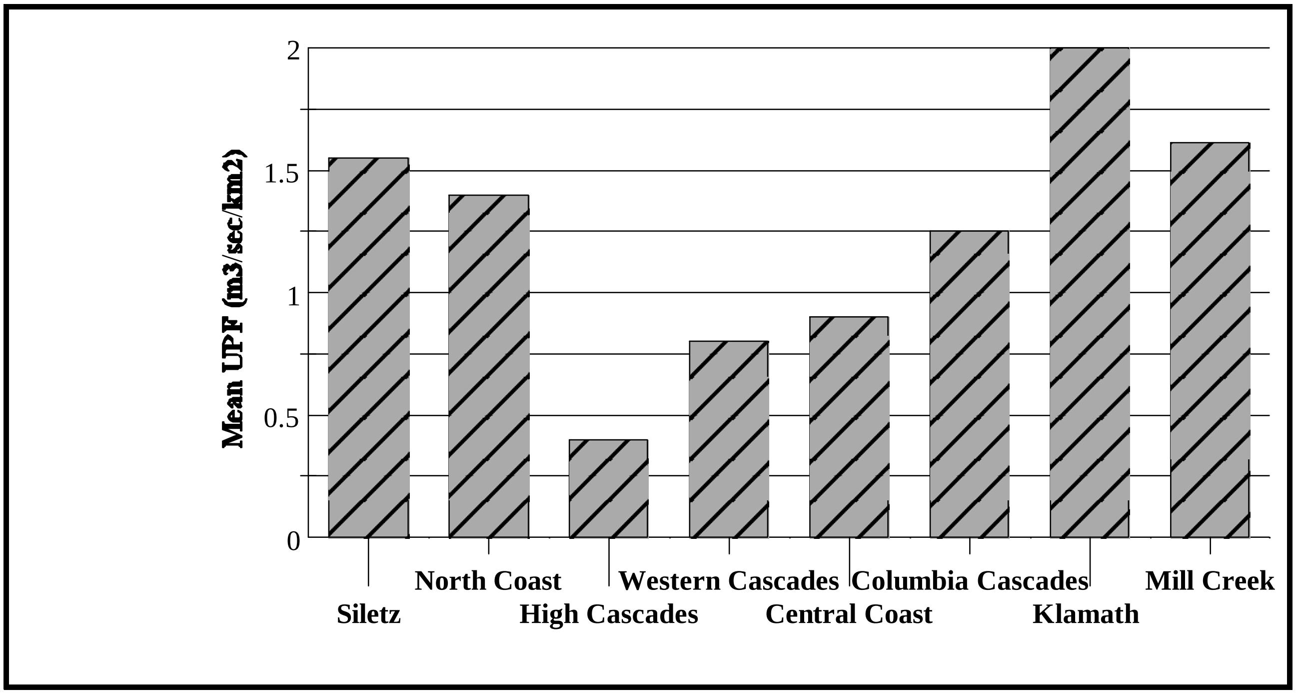

Figure III-2. Regional Comparison of Unit Peak Flow (UPF) with Mill Creek

of BLM ownership in these subwatersheds) is in the TSZ. The TSZ is particularly vulnerable to extremes in storm events and represents an area of high risk for road construction and timber harvest. Roads in this area, particularly on unstable sites, are a high priority for decommissioning or upgrading.

Compounding the sensitivity of these areas is the high percentage of steep slopes in these same subwatersheds (approximately 12 percent of the land base is > 60 percent slope). Once again, the BLM manages a disproportionate percentage of steep lands in these subwatersheds (2,204 acres or 58 percent of the total in Mill Creek).

At the Mill Creek gauging station, average monthly discharge in August from 1958-1973 was 6.2 cfs, or approximately 0.022 cfs/mi^2 average unit base flow. This is an extremely low average unit base flow as demonstrated by comparison with the North Fork Alsea at 0.40 cfs/mi^2 and even 0.06 cfs/mi^2 on the Long Tom River at Monroe prior to the dam (following the construction of the Fern Ridge Reservoir, base flow increased to 0.22 cfs/mi^2). The lowest recorded base flow on Mill Creek was 0.7 cfs measured on the 23rd of August, 1966.

Base flow in Mill Creek has likely been reduced from reference condition as a result of channel and floodplain degradation. Many of the Mill Creek watershed's floodplains appear to have been highly altered from pre-settlement conditions (see "Stream Channels," p. R&CC-25). Hypothetically, the area is vulnerable to measurable reductions in summer base flow as a result of these alterations, but pre-settlement data are not available to confirm this.

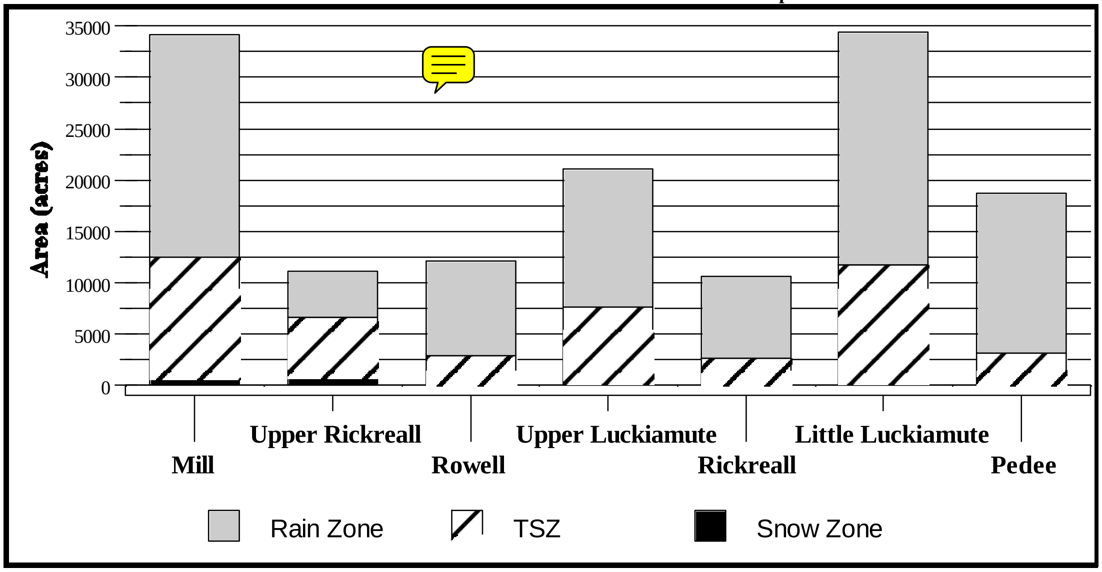

Figure III-3. Snow Dominated Zone, Transient Snow Zone and Rain Dominated Zone by Subwatershed in the Analysis Area

In addition to the low summer base flows of Mill Creek related to seasonal fluctuations, two legal components, water rights and minimum flow requirements, significantly diminish the availability of natural flows. The volume of water involved in these rights and diversions has resulted in conflicting demands for the available resource, particularly during the low flow season.

For the forested portions of the analysis area, an underlying base of fine-grained sedimentary and volcanic rocks of low porosity and permeability limits groundwater resources significantly. Groundwater resources in these areas are generally poor except for some alluvial terrace and flood-plain deposits bordering streams, which serve as fair aquifers and are critical to the maintenance of riparian and wetland habitat during summer base flow. However, the uplands, particularly in the Siletz River Volcanics in the northern portion of the analysis area, are important source areas for groundwater in the lower valley. Precipitation infiltrates fracture zones in the Volcanics and moves down gradient to alluvial zones in the lower valley area.

Groundwater resources are concentrated predominantly on private lands in the unconsolidated sediments deposited adjacent to the Coast Range in the alluvial areas of the large rivers (Willamette, Luckiamute, Rickreall and Mill). Smaller aquifers, such as along the Luckiamute River in Kings Valley, are generally low yielding but of good quality (Penoyer and Niem 1975). Larger aquifers with higher yields are located in the Willamette silts along the Willamette River floodplain. Aquifers in this material are capable of yielding moderate to large (as much as 500 gallons per minute) quantities of water to wells, sufficient for irrigation purposes. In 1974 it was estimated that these deposits in the Corvallis-Albany area stored 750,000 acre-feet of water at depths between 10 and 100 feet. The quality of this water was generally good, with the exception of some evidence of coliform bacterial contamination.

While controversy continues to surround the issue of forest management effects on stream discharge, the most recent research in the region argues that peak discharge in harvested subwatersheds the size of Mill Creek display increases of as much as 100 percent (Jones and Grant 1995). These increases are attributed to changes in flow routing due to roads and to changes in water balance due to treatment effects and vegetation succession. In addition, studies have found long-term reductions in summer baseflows in managed watersheds which are attributable to alterations of riparian vegetation and the degradation of floodplains and wetlands.

No analysis of peak flow increases or reductions in summer baseflow in the analysis area was conducted for this report. However, the soils and vegetation sections of this analysis indicate that the forested uplands have been altered by extensive harvesting, compaction and displacement of surface soils, and road construction. As a result, the timing and quantity of peak flows are likely to have been altered from reference condition in much of the analysis area; no attempt has been made to quantify this effect. Future iterations of watershed analysis may wish to employ computer modeling to test this hypothesis.

Reductions in baseflow resulting from conversion of riparian vegetation and the degradation of channels, wetlands and floodplains have also likely occurred, although the effects of such reductions are concentrated in the depositional reaches in the agricultural lowlands.

The analysis area has a total of 914 miles of road with an overall road density of 4.1 road miles per square mile. Highest road densities occur in the Rickreall and Luckiamute subwatersheds, with densities of 4.8 and 4.7 mile/mi^2, respectively (see Figure III-4, p. R&CC-12). Sixty percent of total road mileage exists in three subwatersheds with the greatest concentration of forest management: Little Luckiamute, Mill Creek, and Luckiamute, with 235, 170, and 159 miles of road, respectively. Ninety miles of road (10 percent of total road length) are currently located within riparian zones (based on interim riparian widths of the Northwest Forest Plan). The Aquatic Conservation Strategy requires that these roads be closely evaluated for their impact on aquatic functioning, so these sections of road are candidates for closure/decommissioning/upgrading (see "Transportation Management," p. R&CC-63).

Extension of the stream network at road intersections has been cited as a principal causal agent in the alteration of peak flow timing and amplitude (Jones and Grant 1995). Mechanisms of channel extension include the capture and routing of precipitation and snow melt from compacted road surfaces to streams, and the interception of groundwater at road-cut banks and subsequent routing to streams. Effective channel lengths appear to have increased by about 300 miles (20 percent overall within the analysis area). This is a conservative estimate compared to the overall 57 percent increase in effective stream length measured in a study on forested lands in the Cascades (Wemple 1994).

An additional element implicated in the alterations in the timing and amplitude of peak flows is the temporary conversion of mature forest to early-seral stage vegetative cover following harvest. The mechanisms most often cited for this effect are the reduction in evapotranspiration, increases in surface flow, and increased snow packs associated with openings. These effects are expected to last

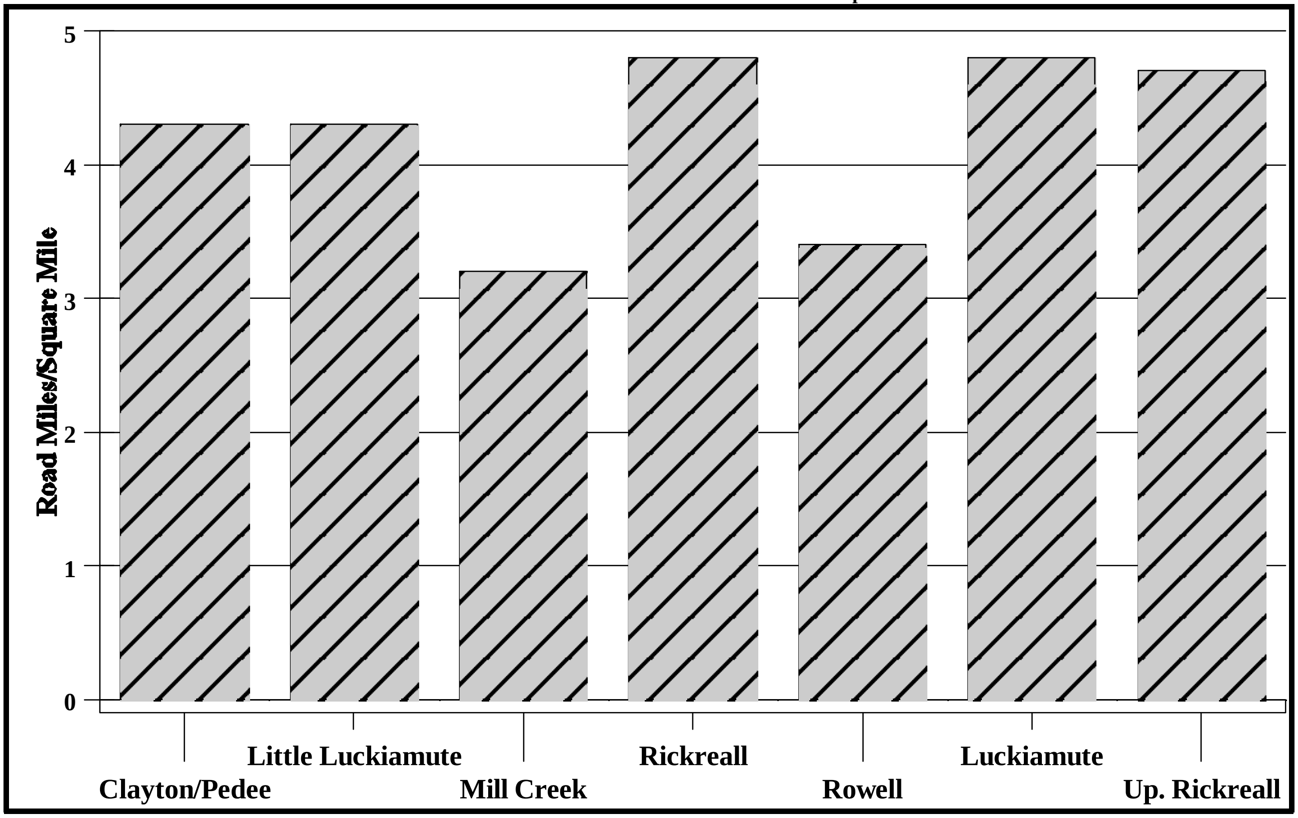

Figure III-4. Road Densities by Subwatershed in the Analysis Area

approximately ten years following harvest. Currently, 48 percent (68,432 acres) of the analysis area is composed of early-seral vegetation (Figure III-5, p. R&CC-13). Mill Creek (16,788 acres) and Little Luckiamute (15,008) subwatersheds have the largest acreage in early-seral vegetation while the Upper Luckiamute has the highest percentage of early-seral (59 percent). Thus, nearly half of the forested portions of the analysis area are in early-seral age class vegetation. An astounding 96 percent of the analysis area is 80 years or younger, indicating that nearly the entire analysis area has been disturbed at least once (and in many cases twice or more) this century.

The State of Oregon's water appropriations doctrine is based on " first-in-time/first-in-right." Holders of water rights are granted priority dates corresponding to the date of application. These rights are held as long as state requirements continue to be met. The state also requires that a use or withdrawal right be directly applicable to a designated beneficial use. For the analysis area, beneficial uses of surface waters include domestic water consumption, fisheries, agriculture (including irrigation and livestock), recreation, wildlife, fire control, and power. Although there are withdrawal rights for domestic consumption on all the major tributaries, most rights are for irrigation.

There are four cities in the analysis area which treat surface water for their municipalities (see Map MP-9). The City of Dallas withdraws from Rickreall Creek, Falls City takes surface water from Teal Creek and Camp Kilowan Spring, the town of Sheridan withdraws water from the Yamhill River (to which Mill and Rowell creeks are tributaries), and Monmouth makes its withdraws from Teal Creek. The primary concern in these municipal watersheds relative to forest management is the level of fine

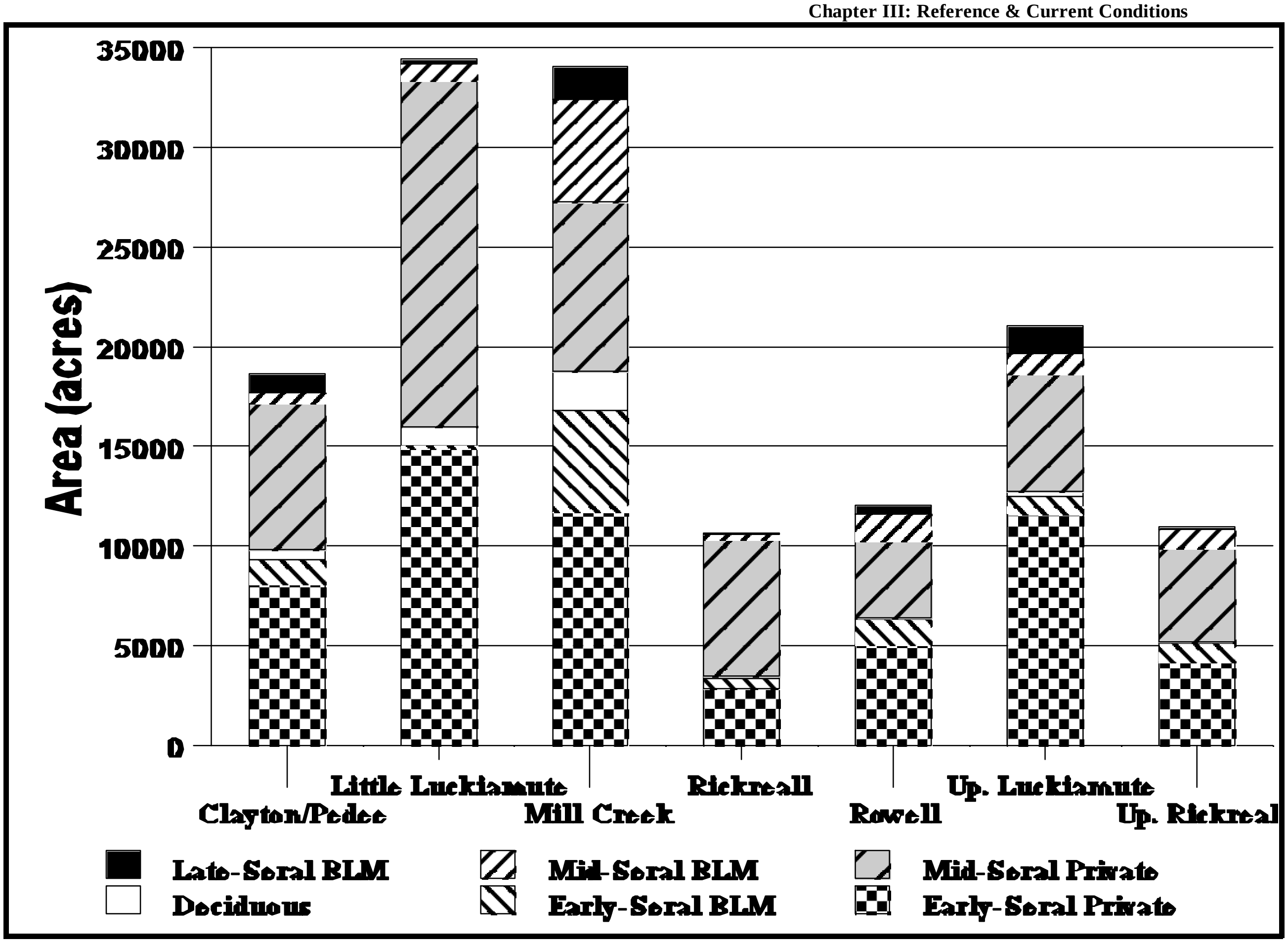

Figure III-5. Seral Stages by Subwatershed in the Analysis Area

sediment in the water. High turbidities during winter peak flows may make the water difficult and/or too expensive to treat (turbidity is reviewed under "Water Quality," p. R&CC-30).

In June 1966 the Oregon State Water Resources Board (now the Water Policy Review Board) established minimum flow reservations "for the purpose of maintaining a minimum perennial streamflow sufficient to support aquatic life and recreation." All water rights granted after the June 1966 date are subject to the minimum flow reservations. This has resulted in the appropriation and utilization of essentially all available streamflows in the analysis area during the late summer and early fall period of critical years. During drought years, water appropriations on most streams in the analysis area likely exceed base flow capacity.

VEGETATION

FIRE & FOREST UPLANDS: Reference Conditions

In general, prior to Euro-American settlement the analysis area consisted of giant (>10,000 acres) to medium (100 to 1,000 acres) sized areas of homogenous forest. Disturbances such as fire, wind, insects and disease have been significant in affecting the age class and species distribution of vegetation in the Coast Range.

Fire has been the primary large-scale disturbance factor influencing vegetation in the Oregon Coast Range. (See Appendix IV for a discussion of fire history in the Coast Range.) The nature of the Coast Range forests prior to 1900 was largely determined by the intensity, frequency and extent of the natural fire regimes associated with particular areas of the forest (Walstad et al. 1990; Agee 1993). The predominance of Douglas-fir in this region at the time of Euro-American settlement was due largely to periodic disturbance by fire as well as the longevity of the Douglas-fir species (Agee 1991).

High intensity, stand-replacement fires occurring at irregular intervals of 150-400 or more years (Teensma 1991) likely affected the western third of the megawatershed area, similar to much of the rest of the central Coast Range. The middle and eastern thirds of the megawatershed were undoubtedly subjected to much more frequent, less intense fire, due to valley burning by the native people, and the drier growing conditions in this portion of the megawatershed due to the rain shadow effect of the Coast Range. Burning by Native Americans is widely documented (Boyd 1986, Zybach 1988, Agee 1993, Mintoyne 1968, Towle 1982). Prior to Euro-American settlement in the 1840s, Native Americans inhabited the Willamette Valley at least as far back as 10,000 years ago; Kalapuya Indians inhabited the lower elevations of the megawatershed during its earliest recorded history. These Indians managed vegetation and game habitat in the Willamette Valley by periodic burning; in fact, annual burning of many areas of the valley and foothills was common practice up until the 1850s.

This frequent burning reduced or eliminated trees and brush over wide areas. In the xeric moisture zone (valley and foothills less than 1,000 feet in elev.), a savannah with scattered oak, maple and Douglas-fir was the predominant vegetation type resulting from this frequent burning. Excerpts from surveyors' records of the 1880s (Wright 1880) describe the Willamette Valley and foothills area around the town of Dallas and Falls City as "grass prairie with scattered trees mostly oaks on the low hills." The stands of dense timber were in the high mountains in the western third of the megawatershed. Surveyors' notes referencing the mountainous land in T. 9 S., R. 7 W., describe "vast stands of fir and hemlock timber standing as thick as it can grow." In 1880, Wright, in reference to T. 7 S., R. 7 W., also wrote, "This township lies wholly in the mountains of coast range and is thickly covered with timber of the finest kind... It is almost impossible for the deputy (surveyor) to locate anything off his line on account of the dense undergrowth and timber."

Generally, wind, insects and disease result in more subtle effects on the forest vegetation when compared to the more dramatic changes that occur as a result of intense fire in the forest. Severe windstorms have created areas of concentrated blowdown as well as areas of smaller, broadly scattered patches and individual tree openings. Scattered patches of windthrow result in a decrease in the continuity and homogeneous nature of the forest canopy. In much the same way, insects and disease create scattered openings in the forest over time, resulting in greater diversity of species and age within a stand.

The natural succession of the plant communities following a disturbance event was dependent on how severe and widespread the disturbance had been. Following severe fires, large patches of the landscape were left completely denuded, often revealing exposed soil. Under such conditions, the succession of plant communities often began with grasses and forbs whose seeds were carried in on the wind. As time progressed, the grass/forb community would usually give way to shrub species and small sapling trees. Most often a young conifer forest would become established and eventually progress to late-seral or old-growth conditions before another disturbance event occurred.

The duration of each seral stage could be quite variable. For example, the grass/forb and shrub community was known to persist for a few decades in certain areas of the Coast Range following the intense fires of the mid-1800s. Lack of a seed source, shrub competition, and reburns have all been identified as factors in delaying the regeneration of disturbed areas to a forested condition (Agee 1993).

Successional pathways can be very different following less severe disturbance events. For instance, following a low intensity fire, only shade tolerant species may be able to establish themselves among the surviving vegetation and overstory trees. In contrast to the even-aged stands regenerating after a severe disturbance, stands that develop following less intense under-burns often have multiple canopy layers and more structural diversity. Local site conditions such as soil conditions and available moisture will also affect the successional pathways of plant communities following a disturbance.

For several thousand years, the western hemlock/Douglas-fir forests of the Coast Range have been responding dynamically to both large-scale and localized disturbance events. The condition of the vegetation occupying the landscape at any one time could therefore be quite variable. The enormous acreages affected by major fire events could far surpass the size of any single watershed. Considering this fact, it is easy to conclude that forest conditions within a watershed could naturally have ranged from completely burned over to completely covered in late-seral forest conditions. We know from reconstruction of historic forest inventory records (Teensma et al. 1991), forest vegetation potential (Franklin and Dyrness 1973), and fire return intervals (Agee 1993), that on average, late-seral and old-growth forests occupied 60 to 80 percent of the Coast Range landscape. Ripple (1994) estimated that 61 percent of the Coast Range was occupied by late-seral forests prior to 1850. Perhaps 20 to 40 percent of the Coast Range was typically in early seral conditions, resulting from recent fires or localized disturbances.

Due to the large proportion of area in the megawatershed that is in the xeric zone and the effects from valley burning, the percentage of late-seral forest was lower, perhaps in the 30 percent range. For the analysis area, a best estimate from available maps indicate that at the turn of the century, 64 percent was in mature and recently cut forest (assumed to have been mature prior to cutting). At any single point in time, depending on how large an area is analyzed and on the frequency and intensity of fire events, the range could have been 0 to 100 percent of the forest in late-seral stage. This is especially likely when smaller areas are considered.

FIRE & FOREST UPLANDS: Current Conditions

According to surveyors' records of the 1880s and early forest type maps of 1901 and 1936, the heavily timbered areas of the megawatershed were located in and west of R. 7 W., except for a small area in the steeper lands of R. 6 W. around Falls City. The 1936 map also documents some eastward advancement of the general forest edge, probably resulting from fire exclusion.

In general, the analysis area today consists of many, smaller areas of younger age class timber than was the case during reference conditions. The landscape is fragmented by the many miles of roads and many small timber management areas. A shift in dominant patch size from giant (greater than 10,000 acres) and medium (100 to 1,000 acres) to small (less than 100) acres has occurred in the analysis area. The number of patches across the landscape in late-seral condition has more than doubled from fragmentation, but the amount of the analysis area in late-seral condition has been reduced. These trends — decreases in patch size, increases in the number of patches, and a significant reduction in the amount of late-successional habitat — have contributed to late-successional habitat loss and fragmentation across the analysis area.

Since the turn of the century, the "cycle" of large, periodic stand-replacement fires has been disrupted by fire protection measures and timber harvesting patterns. Rapid response to extinguish all fire starts and the discontinuous arrangement of fuels (timber stands) due to clear-cutting and roads has kept most fires small. The largest fire in the analysis area this century has been the 5,001-acre Rock House Fire that burned just west of Rickreall in 1987.

Clear-cut timber harvests followed by prescribed burning have been the major "stand replacement" events occurring in the analysis area in this century. The small patch size (relative to uncontrolled natural fires) and the low numbers of snags remaining in most clear-cut units have resulted in a different overall landscape pattern than what would be expected under natural conditions.

The current condition of vegetation is that of greatly reduced structural diversity and species composition. This is due primarily to forest management activities such as: 80 year rotations; leaving few to no snags per acre after regeneration harvest; retaining small to no buffer zones adjacent to streams (in contrast to the Northwest Forest Plan); prioritizing harvest on older stands; removal of suppressed trees, windthrown timber, coarse woody debris and snags; planting monotypic stands; and slashing and burning units post-harvest.

The major plant associations represented within the analysis area are the western hemlock plant associations as listed in *Plant Association and Management Guide* (Hemstrom and Logan 1986). These associations were defined for Suislaw National Forest lands which are intermingled with Salem District BLM-administered lands in the Oregon Coast Range. These plant associations apply to the upland analysis areas that are dominated by conifers (Douglas-fir and western hemlock). The eastern and northern portions of the analysis area dominated by big-leaf maples, Oregon ash, Oregon white oak and grasslands are generally referred to as the oak savannah/grassland plant associations. Plant association types are useful in predicting the potential effects of timber management actions and in determining possible silvicultural prescriptions for the site.

Coniferous forests make up the majority of the current vegetation classes within the analysis area. Map MP-3 shows the current seral-stage and age classes of the vegetation in the analysis area. This map was created through the use of Forest Operations Inventory (FOI) records for BLM lands and through the use of Land-Sat imagery for private lands. Therefore, the BLM statistics and mapping are relatively accurate, but the private lands are estimated through the use of satellite photography and interpretation. Table III-2 shows seral stage acres by subwatershed.

Table III-2. Seral Stage Acres by Subwatershed

Subwatershed	Early-	Mid-	Late-	Old-growth	Hardwoods	Non-forest
Clayton/Pedee	9,312	7,863	48	918	490	9
Little Luckiamute	15,008	18,231	20	256	940	10
Mill Creek	16,788	13,717	345	1,289	1,954	124
Rickreall	3,338	7,090	63	0	137	12
Rowell Creek	6,361	5,177	50	396	87	18
Upper Luckiamute	12,476	6,937	277	1,087	276	24
Upper Rickreall	5,130	5,645	80	58	49	79
Totals	68,413	64,660	883	4,004	3,933	276

Early-seral = 0-39 years; Mid = 40-79 years; Late = 80-199 years; and Old-growth = 200+ years. The total analysis area in acres = 142,169.

Hardwood stands, which account for approximately 2.8 percent of the analysis area, usually occur in one of three conditions: 1) interspersed with conifer stands or in unmanaged conifer stands; 2) in naturally disturbed areas; or 3) as linear-shaped habitats along road systems and streams. It is important to note that the oldest seral stages (late and old-growth) currently represent approximately 3.5 percent of the analysis area (excluding hardwood and non-forest acres), while the younger seral stages (early and mid) account for approximately 96.5 percent of the analysis area (excluding hardwood and non-forest acres).

Table III-3 (p. R&CC-18) lists total acres within the analysis area for both private and BLM in the four conifer-dominated seral stages. BLM owns approximately 18.2 percent of the total conifer-dominated analysis area but approximately 100 percent of the late- and old-growth seral stages. BLM also owns approximately 17.9 percent of the early and mid-seral stages.

Table III-3. Conifer Seral Stages by Ownership

Seral Stage	Total Acres: Private	Total Acres: BLM	% BLM Ownership
Early	58,364	10,049	14.7%
Mid	54,538	10,122	15.7%
Late	0	883	100%
Old-Growth	0	4,004	100%
Totals	112,902	25,058	18.16%

See Appendix I for tables describing seral stages for each subwatershed in the analysis area

RIPARIAN RESERVES: Reference Conditions

Riparian areas can be categorized into two general types. Along higher order streams with distinct floodplains and floodplain terraces, there are wide bands of riparian vegetation interspersed with meadows and other gaps. The streams associated with these bands of riparian vegetation generally correspond to response and deposition reaches (see "Hydrology" section, p. R&CC-6). Hardwoods dominate areas with high water tables and those which are subject to frequent disturbance. Most of the agricultural lowland riparian forests in the analysis area fit this description: streams flowing through lowlands are bounded by gallery forests, containing mostly hardwoods. Relatively frequent, low intensity floods are the leading cause of disturbance.

The western portion of the megawatershed area, where most BLM land is located, is generally characterized by steeper topography and higher gradient, lower order streams which generally correspond to source and transport reaches. Flood plains are narrow or nonexistent, and side-slopes are relatively steep, resulting in vegetation along the stream edge which is similar to that upslope, mostly conifers. Disturbance from debris flows, landslides, or fires is generally infrequent and catastrophic.

No one really knows the relative proportion of hardwoods to conifers along Coast Range streams prior to European settlement. One study found that red alder is common in logged stands but rare along streams in undisturbed stands over 100 years old (Minore and Weatherly 1994), implying that the logging and road building in the second half of this century caused disturbances which favored alder establishment. However, a study cited by Emmingham and Hibbs (1997) found that 80 percent of the areas within 30 feet of streams in undisturbed stands 150 years old contained either hardwoods or no trees at all, implying that most riparian forests historically lacked conifers. Paleoecological studies also cited by Emmingham and Hibbs (1997) found evidence that alder was more common 500 to 1,000 years ago in the Coast Range than it is today.

Relative importance and abundance of conifers and hardwoods in riparian areas appears to have varied through time and over the landscape. Instead of citing a proportion of hardwood/conifer in riparian forests under reference conditions, it may be better to look at long-term goals for Riparian Reserves and decide how vegetation composition meets or does not meet those goals.

It is likely that stands in later seral stages occupied a larger percentage of riparian areas than they do today. Ripple (1994) cites a source which found that third- and fourth-order streams in the Coast Range had a large number of old-growth patches due to wet conditions and lack of human use. Conversely, riparian areas around first- and second-order streams likely experienced more disturbance from fire due to conditions similar to the uplands. Therefore, stands on interior, north-facing slopes along third-order and higher streams most likely had the highest number of late-seral and old-growth patches, and riparian stands in the foothills and savanna on south-facing slopes probably had fire disturbance at shorter intervals and thus more early seral patches. Most riparian areas lie between these two extremes, presumably with older forests averaging about 60 percent of the land area. (See discussion in "Fire and Forest Uplands," pp. R&CC-14, 16).

As discussed in "Fire and Forest Uplands" above, at any given time 0 to 100 percent of an area could be in late-seral stands. Therefore, depending on the recent disturbance history, streams could be entirely shaded, entirely open, or anything between. The major differences would be that disturbance would be less frequent than now, and remnant patches would often (but not always) remain along streams after a disturbance. Late-seral stands produce large conifers which are considered the highest quality coarse woody debris (CWD) because they take centuries to completely decay, providing long-term habitat for terrestrial and aquatic species. Because there was a higher proportion of late-seral and old-growth stands in the past, CWD recruitment potential was presumably higher overall. Even in stands with a recent major disturbance, or stands dominated by hardwoods, large, old, remnant trees often remained, singly or in patches, providing high quality CWD recruitment along streams.

Riparian Reserves were created by the NFP partly to serve as late-seral connectivity through a watershed and between watersheds. If we assume that approximately 60 percent of the Coast Range, including riparian stands, was historically in late-seral forest occurring in large contiguous patches, then we can assume late-seral connectivity existed between watersheds through riparian corridors.

RIPARIAN RESERVES: Current Conditions

Seral stages in Federal Riparian Reserves (BLM and Forest Service) and Oregon Forest Practices Act (OFPA 1997 [revised]) buffers (State and private land) were analyzed, as shown in Table III-4 (p. R&CC-20).

Riparian Reserves were mapped in GIS using slope distance (see Map MP-4). They constitute approximately 50 percent of BLM land in the analysis area, and 10 percent of the total analysis area. Most BLM ownership is in the foothills and interior upland portion of the analysis area where conifer stands predominate. Riparian vegetation in the analysis area as a whole is characterized by lack of late-seral and old-growth habitat. Riparian stands older than 80 years account for 16 percent of the analysis area's total riparian acreage, far less than reference conditions.

Table III-4. Seral Stages in Federal Riparian Reserves and State Buffers[1]

Conifer Seral Stage	BLM/FS Riparian Reserve Acres	% of Total BLM/FS Riparian Reserves	State/Private OFPA Buffer Acres	% of Total State/Private OFPA Buffer Acres	Total Seral Stage Acres	% of Total Analysis Area Acres
Early-Seral (0-39 yrs.)	5,325	38	3,639	58	8,964	6
Mid-seral (40-79 yrs.)	6,244	45	2,105	34	8,349	6
Late-seral (80-199 yrs.)	423	3	0	0	423	<1
Old-growth (200+ yrs.)	1,758	13	0	0	1,758	1
Hardwoods	182	1	482	8	664	<1
Total	13,932	100	6,226	100	20,158	13

[1]Federal Riparian Reserve widths equal 210 or 420 feet, depending on fish presence. OFPA buffer widths are 20 to 150 feet, depending on fish presence and other factors. For purposes of the GIS analysis, private buffers were given an average of 50 feet.

Riparian stands with older forest characteristics such as large trees, diverse species, multi-layered canopies, snags and decaying down wood, and scattered open patches are generally lacking in the analysis area and will take a long time to develop without further management. Approximately 83 percent of the Riparian Reserves are less than 80 years old (see Table III-5, p. R&CC-21). Most of them were logged and allowed to seed in, and are generally uniformly even-aged Douglas-fir stands, with a minor component of other conifers and hardwoods in the same canopy layer. Only one mid-seral stand is classified as having an understory. These stands may require density management to promote desired characteristics.

Although no formal coarse woody debris (CWD) surveys have been done in the Riparian Reserves, informal reconnaissance of some stands indicates that some logs and snags were left as a result of logging. These down logs and snags are now in decay class three through five. Stands generally lack younger CWD and snags.

Table III-5. Density Management Opportunities in Riparian Reserves

SUBWATERSHED	Acres in Age Class 21-50 Yrs.	Acres in Age Class 51-80 Yrs.
ROWELL		
LSR within RPAs (NS)	486	114
LSR outside RPAs	16	557
AMA	2	29
Subtotal	500	700
UPPER LUCKIAMUTE		
LSR within RPAs (NS)	433	20
LSR outside RPAs	0	10
AMA	0	0
Subtotal	433	30
MILL CREEK		
LSR within RPAs (NS)	3,350	47
LSR outside RPAs	794	168
AMA	9	0
Subtotal	4,153	215
LITTLE LUCKIAMUTE		
LSR within RPAs (NS)	160	3
LSR outside RPAs	0	0
AMA	24	73
Subtotal	184	76

SUBWATERSHED	Acres in Age Class 21-50 Yrs.	Acres in Age Class 51-80 Yrs.
CLAYTON/PEDEE		
LSR within RPAs (NS)	**407**	**27**
LSR outside RPAs	**0**	**0**
AMA	**29**	**0**
Subtotal	**436**	**27**
RICKREALL		
LSR within RPAs (NS)	**0**	**0**
LSR outside RPAs	**0**	**0**
AMA	**208**	**46**
Subtotal	**208**	**46**
UPPER RICKREALL		
LSR within RPAs (NS)	**12**	**0**
LSR outside RPAs	**658**	**303**
AMA	**19**	**5**
Subtotal	**689**	**308**
Total	**6,603**	**1,402**

LSR=Late-Successional Reserve; AMA=Adaptive Management Area; RPA=Reserve Pair Area; and NS=Non-suitable habitat within RPAs

There are two areas where BLM Riparian Reserves in the analysis area connect with Riparian Reserves and LSR in an adjacent watershed (see Map MP-5):

! Riparian Reserves in the Mill Creek (T. 7 S., R. 8 W., sec.13) and Rock Creek (T. 7 S., R. 8 W., secs. 13 and 14) drainages connect with Boulder Creek Riparian Reserves (T. 7 S., R. 8 W., sec. 23) in the Upper Siletz watershed.

! Riparian Reserves in Rickreall Creek also connect with Boulder Creek Riparian Reserves in the Upper Siletz Watershed (T. 7 S., R. 7 W., sec. 31).

In both of these areas, stands are 50 to 60 years old and may require density management to promote older forest characteristics. Elsewhere, BLM Riparian Reserves are adjacent to private land.

Although stream temperatures are influenced by a range of processes, shade provided by bank vegetation can be an important factor during periods of low flow (see Map MP-6). Riparian vegetation within 15 meters of streams was analyzed for age and species composition on federal and private lands, using GIS (Table III-6, below). All streams occurring in stands over 10" DBH, including hardwood-dominated sites, were considered to be at low risk for increased stream temperatures due to lack of shade. Seventy-seven percent of the streams on BLM and private land are within this category. Federal lands comprise only 7 percent of the area considered at risk for high temperatures.

Table III-6. High Temperature Risk At Low Flow Due to Lack of Shade[1]

RISK	BLM/FS ACRES	STATE/PRIVATE ACRES	% OF TOTAL ACRES
LOW[2]	268	3,723	23
HIGH[3]	3,352	9,725	77
TOTAL	3,620	13,448	100

1. All acres are within 15 meters of second-order and higher streams.
2. Low potential for risk due to lack of shade = conifers, hardwoods, and mixed conifer/hardwood stands greater than 10" DBH.
3. High potential for risk due to lack of shade = stands less than 10" DBH, and non-forested areas.

Vegetation within 30 meters of streams in the analysis area was classified by composition and age on federal and private land using GIS (see Table III-7, p. R&CC-24). CWD in the stream is recruited from within 30 meters of the stream (FEMAT 1993), and the best quality (high potential) CWD is considered to be conifers over 80 years old (see Map MP-7).

CWD potential for the whole analysis area is currently low because Riparian Reserves and OFPA buffers lack stands with trees greater than 20" DBH. Currently, 30 percent percent of federal lands and 12 percent of private lands have high CWD potential. Moderate CWD potential, which includes mid-seral conifer, and mid-seral and older hardwood stands, constitutes about one-third of the federal Riparian Reserves. Low potential for CWD recruitment includes young conifer plantations and hardwood stands, and non-forested areas, which together constitute approximately 35 percent of federal Riparian Reserves.

Table III-7. CWD Recruitment Potential in Streams[1]

POTENTIAL	BLM / FS ACRES	STATE / PRIVATE ACRES	% OF TOTAL
LOW[2]	2,522	15,092	51
MODERATE[3]	2,437	8,725	33
HIGH[4]	2,176	3,354	16
TOTAL	7,135	27,171	100

1. Acres within 30 meters of streams.
2. Low potential for CWD recruitment = conifer and mixed conifer/ hardwood stands less than 10" DBH, non-forested areas, and hardwood stands of all sizes.
3. Moderate potential for CWD recruitment = conifer stands 10-19" DBH and mixed conifer/hardwood stands of all sizes.
4. High potential for CWD recruitment = conifer stands over 20" DBH.

STREAM CHANNELS: Reference Conditions

Historically, the processes which control stream channel morphology and sediment transport are assumed to be the same as those currently observed. Characteristics of stream channels and sediment transport in the analysis area are also likely to have varied during the Holocene in response to climatic conditions interacting with natural disturbance patterns.

Glacial activity in the late Pleistocene and early Holocene resulted in high erosion rates and valley filling. The Missoula Floods alone deposited several hundred feet of silt material in the Willamette Valley and in the watersheds of tributaries such as the Luckiamute and Yamhill. Climatic patterns likely resulted in a tendency towards channel aggradation (increased storage of sediment and organic material in the channel) which probably resulted in pool filling, increased braided channels, and more floodplain deposits. Increased sediment supply was likely accompanied by reduced streamflow competence (ability to transport material) due to reductions in peak flow events.

During the last 8,000 years when the post-glacial climatic disturbance regime led to the estab-lishment of coniferous forests, stream channels have also adapted to altered patterns in flow and sediment. Increases in sea level flooded lower river valleys and produced large, slow water estuaries along the Oregon coast at the outlet of the major river systems. Post-glacial periods are generally associated with reduced rates of erosional processes and a tendency toward channel cutting through the deposits left by glacial activity. Former floodplains were abandoned as streams mobilized and transported earlier deposits, entrenched into the stream bed, and cut banks. Evidence of this process is particularly clear in the lower reaches of Mill

Creek, which has a streambed 50 to 70 feet below the surface it leveled during the glacial period.

These processes were further altered in a spatial dimension. The lowlands along the main channels of Mill and Rickreall creeks and the Lukiamute River have an overall tendency (due to low gradients and an unconfined setting) toward storage of water, along with accompanying fine sediment deposition on flat, alluvial flood plains and in the channel. Stream velocities were low and water tables high throughout the year, and the potential for pools, backwaters, and alcoves was substantial. These conditions dampened seasonal variability and resulted in highly stable and diverse aquatic habitat (both in-channel and on the adjacent floodplain) in mainstem channels and adjacent tributaries. Low stream energy and high water tables likely buffered disturbance events and maintained stable conditions.

In addition, these conditions were likely to be highly conducive for beaver colonization. Beaver dams further reduced stream velocities, and sediment and water movement through the system while increasing flooding, channel cutting and meander. These dams were also highly influential for aquatic habitat types and conditions. Due to the depositional nature of this area, it is likely to be highly susceptible to alterations in the chemistry of incoming sediment and water.

Upland channels formed in response to higher gradients and the accompanying increase in stream energy while interacting with local soils and surface geology. Channels likely cycled through an aggraded, sediment and CWD-choked condition to a degraded, bedrock form in response to adjacent hillslope disturbance regimes. The largest source of stream substrates was ravel from over-steepened hillslopes whose feet had been removed by stream erosion. Large conifers entered the channel or lodged just above it following intense storm events with high winds and several inches of rainfall. Over-steepened, ephemeral channels failed during such events and debris torrent material sluiced the channels to bedrock before being deposited at their right-angled confluence with second- or third-order perennial streams. Here the material choked the channel, creating backwaters which trapped gravel-sized substrate and produced further hill-slope cutting. Eventually, the material was slowly reworked and transported downstream or was released suddenly during a catastrophic peak flow event. Where several choke points coalesced, such as at the confluence of two or more high gradient, second-order channels, flats formed from the accumulated colluvial material. These areas were often colonized by beavers, whose structures helped raise water tables and provided highly desirable habitat for some fish species. Hardwood species and western redcedar were especially well adapted to these small, montane depositional areas and helped maintain the unique nature of this riparian/stream habitat.

STREAM CHANNELS: Current Conditions

This report focuses almost exclusively on the Mill Creek subbasin within the analysis area, where public lands are concentrated and where management of those lands has greatest potential to affect channel conditions. Extrapolation of conclusions from Mill Creek to the remainder of the analysis area, with the exception of Upper Rickreall (similar geomorphology and conditions), is not recommended. Except in a few instances, it is not possible to state with confidence whether or not current channel conditions in the remainder of the analysis area have been maintained within the range of reference conditions.

Since this analysis was mostly office-based, augmented by occasional field visits, determination of stream types could only be completed qualitatively to a broad level classification. The categories cited in this analysis are general representations of the reaches described and may include shorter sections with different response potential. Channel gradient and entrenchment were determined from topographic maps, followed by selected field visits, and channel response types were then determined from gradient classes. Overall, the material in this section is adequate for broad planning purposes, but site-specific data and recommendations are necessary to apply these conclusions on a project level.

In general terms, the movement of surface water, sediment, and organic material can be predicted by dividing the stream network into "source," "transport," "response" and "depositional" reaches (see Map MP-8), following the classification of Montgomery and Buffington (1993).

Source reaches have gradients ranging from 8 to greater than 20 percent and are found primarily in headwalls and along steep side-slopes. These reaches, due to their frequency and position on the landscape, are the primary source for much of the water and inputs of organic material, nutrients and sediment in the stream system. They have no floodplain development and commonly flow intermittently or in response to storms. In western Oregon, the riparian zone adjacent to these channels is typically dominated by conifers.

The sensitivity of source reaches to disturbance varies widely with local surface geology and soil types. Sediment and organic material enter these channels through episodic landslides, chronic inputs of surface sediment in the form of "ravel," soil creep and slumping (see "Soils," p. R&CC-2). Periodic, catastrophic disturbances in these reaches are a normal part of watershed ecology in the Coast Range and critical processes in the maintenance of the aquatic ecosystem (Benda 1990).

There are 1,132 miles (76 percent of total stream mileage) of source reach stream channels in the analysis area, 270 miles (24 percent of the total) of which are on BLM managed lands (see Figure III-6, p. R&CC-27). Due to the huge number of source channels and their general inaccessibility, they are rarely investigated in the field. In addition, no standard criteria for characterizing the conditions of these channels are available. As a result, the current functional condition of source reaches in the analysis area is largely unknown.

Transport reaches have a relatively high gradient (4-20 percent), are often resistant to changes in stream morphology, and tend to act as conduits for material from high-gradient reaches to depositional and response reaches. These reaches typically have a cascade morphology, a large cobble or boulder substrate, and resistant banks with little or no floodplain development. They may be intermittent or perennial. Riparian vegetation is variable but tends to be dominated by conifers. There are approximately 225 miles (15 percent of total stream mileage) of transport reach stream channels in the analysis area; 21 miles (9 percent of the total) are on BLM lands. As with source reaches, the current functional condition of transport reaches on BLM lands is largely unknown.

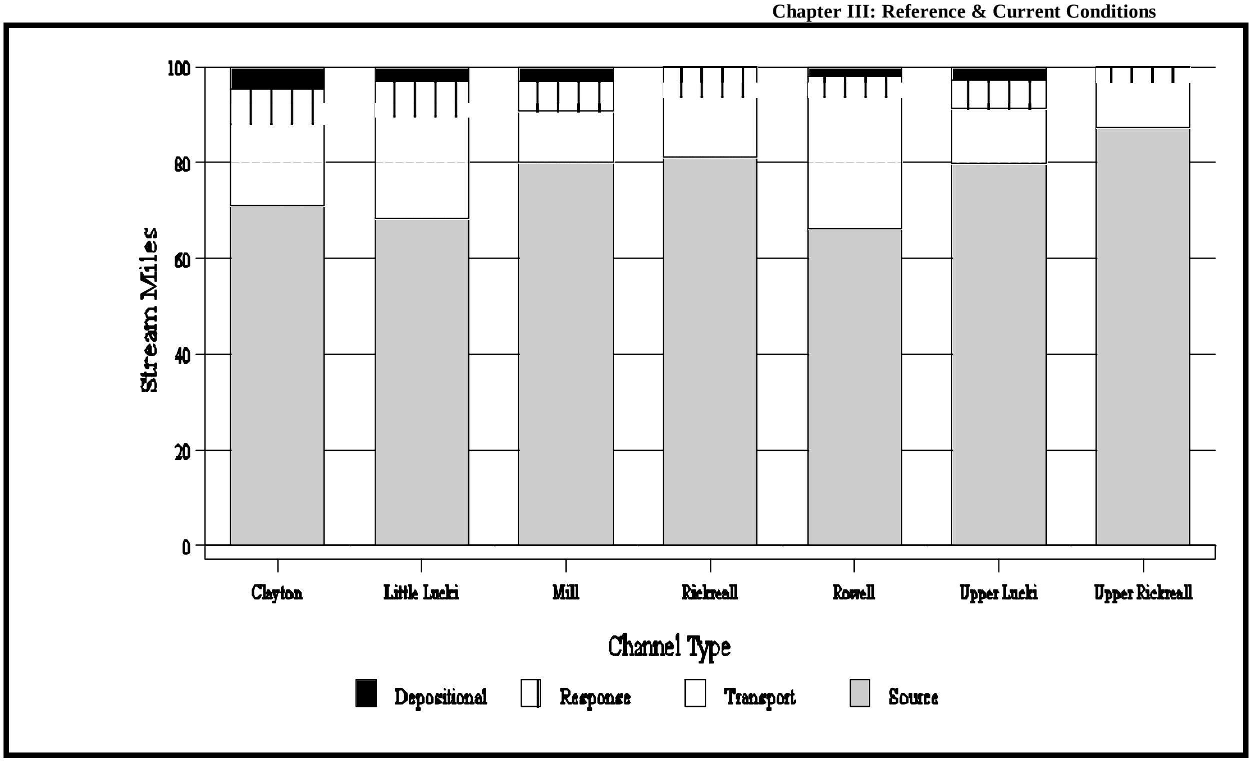

Figure III-6. Reach Types in the Analysis Area

While data are not comprehensive, field investigations to date indicate that source and transport channels in the forested uplands likely have higher sediment loads and reduced roughness, particularly CWD, relative to reference condition (see “Fish Habitat,” p. R&CC-42). On stable channels, the main supply mechanism for sediment appears to be ravel from the adjacent, over-steepened hillslopes. Some of this material, mostly gravels and cobble, is retained, primarily behind dams created by CWD. In many sections where CWD is uncommon, gravels are being quickly transported downstream through long sections of channel degraded to bedrock.

It is highly likely that human activity has accelerated the rate of landsliding above the reference rate, particularly in failure-prone landscapes such as in the Mill Creek watershed and on channels draining Rickreall Ridge (see “Soils,” p. R&CC-2). Over-steepened hillslopes, coupled with large scale disturbance from logging, road construction and high intensity storm events, have resulted in a large number of landslides and debris torrents in these areas. Evidence of this disturbance is visible in the many transport and source channels which are aggraded and widened relative to reference condition.

Response reaches (gradients from 1-4 percent, and moderately confined to unconfined) and depositional reaches (gradients less than 1 percent, unconfined) are areas of sediment deposition, stream meander, and high potential for diversity and abundance of aquatic habitat. These reaches can experience significant changes in stream morphology and aquatic habitat if sediment supplies increase, riparian soils and vegetation are disturbed, flow regime is altered and/or channel elements (substrate, coarse woody debris, meander geometry, width-to-depth ratio, etc.) are disturbed.

Identifying response reaches that are sensitive to disturbance is important because these reaches are often the most critical as aquatic habitat. In addition, the high water tables, large inputs of nutrient-rich organic material, and the protected valley settings of these reaches combine to produce diverse and productive riparian habitat on the floodplain. These reaches are critical for the buffering of stream flows (they reduce floods and support summer base flow) and the maintenance of water quality. Finally, these areas are typically the preferred habitat for beaver and many species of fish, particularly coho salmon (see "Fish Habitat," p. R&CC-42).

The same elements that control a stream channel's physical processes (substrate, coarse woody debris, meander geometry, width-to-depth ratio, etc) are also critical for the maintenance of biological processes. In turn, biological processes and the species supported by them are critical to the proper functioning and maintenance of response reaches. In particular, beaver were historically a huge influence on the functioning of low gradient channels in western Oregon. However, by the start of the 20th Century in almost the entire state, beaver had already been either eliminated or severely inhibited relative to reference conditions (Naiman et al. 1992). The impact this has had on channel conditions and aquatic habitat is difficult to determine, but it likely accounts for much of the degradation that is observed in low gradient channels throughout Oregon.

Additional degradation likely occurred as these lands were settled, homesteaded and first managed for agricultural production. Finally, dramatic increases in sediment and water supply, as well as direct intrusions into channels and riparian areas (splash damming, channel straightening, tree removal and stream cleaning), followed intensive logging in many of these streams.

There are approximately 130 miles (9 percent of total stream mileage) of response and depositional channels in the analysis area**.** The BLM manages 5.5 miles (4 percent of the total) of response reach types, and no (0) miles of depositional type channels. A small portion of response reaches are on private and public lands in the forested uplands, but the majority cross through agricultural areas managed for agricultural and livestock production or small ranches and rural homes. It is critical for the maintenance of the aquatic ecosystem in the analysis area that these reaches be functioning properly. However, qualitative and quantitative field investigation indicate that most of these channels have been highly altered from the reference condition.

Nearly all of the observed response channels in the analysis area are incised and moderately to highly unstable. Channels are "disconnected" from their floodplains (over-bank flooding occurs only during extreme storm events, if at all) which now primarily function as terraces. Water storage in floodplains has been reduced, contributing to the reduction in summer baseflows, and water quality has been degraded. Lateral instability and bank cutting are universal as channels attempt to develop a new equilibrium. This has likely shifted aquatic populations to habitat on the few remaining reaches where conditions are better, if less than ideal, and has lead to an overall reduction in the quantity and quality of aquatic life relative to reference conditions throughout the analysis area.

WATER QUALITY: Reference Conditions

Processes which determined water quality conditions during the Holocene are assumed to be the same as those currently observed. Characteristics of water quality in the analysis area likely varied during this period in response to channel and hydrologic conditions as well as to climatic patterns in interaction with the natural disturbance regime.

Drier periods with significant reductions in precipitation likely resulted in a tendency towards decreases in stream flow, sediment transport, and vegetation shading the stream. This likely resulted in greater variability in stream temperatures (higher in summer, lower in winter) and lower variability in the sediment regime. Increased sediment storage, reduced flow velocities and increased temperatures likely resulted in a series of cascading effects on water chemistry and physical properties which likely affected the distribution and quantity of aquatic species.

Alternatively, wetter periods with increased streamflow and sediment transport, together with the resultant effects on stream channels and the morphology of riparian areas, likely reduced stream temperature variability and pushed water chemistry and physical properties in the opposite direction of those occurring during drier periods. Sediment transport rates and stream turbidity would increase under these wetter conditions.

These characteristics were further altered in a spatial dimension. The lowlands along the Rickreall, Luckiamute, and Mill Creek main stems had an overall tendency (due to the low gradients and unconfined settings) toward lower stream velocities, greater sediment storage, and a high amount of wetland habitats. This likely resulted in higher overall spatial variability in stream physical and chemical characteristics, with open pond areas of slack water differing from zones of faster moving water. However, temporal variability was likely dampened under these conditions. For instance, high water tables all year round and the long-term maintenance of a shaded stream canopy likely maintained stable stream temperatures with little annual and diurnal variation. Due to the depositional nature of these reaches, water chemistry was highly influenced by the chemistry of incoming fine sediment in combination with the general tendencies toward reduction in a flooded, low oxygenated system. Aquatic communities of both plants and animals were likely to have heavily influenced, and been influenced by, water quality conditions in this area as the heavy inputs of organic materials accumulated.

Upstream, in higher gradient, higher energy systems, water quality was less buffered from variations in response to disturbance events, and annual and diurnal climatic influences. Stream temperatures may have been in the high 60s (°F) in small channels whose riparian shade had been removed by fire. Pulses of sediment and leachable nutrients (e.g., phosphorous, nitrate, etc.) entered the channel during winter storms and when fires increased their availability. During stable periods, nutrient concentrations were likely low and often were a major limiting factor in the abundance of aquatic plant and animal life. Higher stream velocities and channel roughness generally kept the waters well oxygenated, and the influence of vegetation and aquatic animals on water chemistry was probably small when compared to the lowlands. Due to the nature of upland soils and surface geology in this area, streams were routinely transporting large quantities of fine suspended sediments which kept streams somewhat turbid or cloudy.

WATER QUALITY: Current Conditions

This report focuses almost exclusively on the Mill Creek subbasin within the analysis area, which is where public lands are concentrated; management of those lands has the greatest potential to affect water quality (WQ) conditions. Except in a few instances, it is not possible to state with confidence whether or not WQ in the remainder of the analysis area consistently exceeds or meets state WQ standards or if WQ is a factor in the degradation of aquatic ecosystems. In particular, we lack data to support conclusions in most of the analysis area with regard to stream temperature, dissolved oxygen, and sediment, all of which are critical factors for the aquatic community, and which have potentially been altered by land management. Conclusions are mostly hypothetical and are based on professional estimate, deduction, and extrapolation. Overall, the material in this section is adequate for broad planning purposes, particularly for suggesting WQ monitoring activities. Site-specific data and recommendations are necessary to apply conclusions from this section to specific projects.

The State of Oregon's water quality standards and rules to protect the designated beneficial uses of state waters apply to all streams in the analysis area, including permanent, ephemeral and intermittent headwater streams under BLM jurisdiction. These standards are set forth in the Oregon Administrative Rules (Chapter 340, Division 41).

Water quality (WQ) data reviewed for this analysis came from the following sources:

- The State of Oregon's Department of Environmental Quality (DEQ). The DEQ is responsible for investigating, evaluating, reporting, and regulating WQ conditions in all state waters; its 1996 303(d) report and the 1989 *Assessment of Nonpoint Sources of Pollution* were reviewed.

- The U.S. Environmental Protection Agency (EPA). The EPA has issued the BASINS software package, which collected surface WQ data contained in the STORET database together with data on toxic sites (i.e., "Superfund"), permitted point sources, municipal watersheds, dams, etc., and placed these in an ARCVIEW software program for analysis and display (EPA 1996).

- Marys Peak Resource Area, which has some WQ data from selected sites on public lands.

Additional WQ data from private sources, state and private schools and universities, EPA, DEQ, or other public agencies may be available but were not located for this analysis.

According to the DEQ's 1996 303(d) list of water quality limited water bodies, the following streams in the analysis area are "Water Quality Limited" (see Map MP-9):

- Mill Creek (Yamhill Subbasin) - Segment #22J-MILLO from the confluence with South Fork Yamhill to headwaters; for stream temperature and water contact recreation (Fecal Coliform), summer only.

- Luckiamute River (Upper Willamette Subbasin) - Segment #22E-LUCKO from the confluence with the Willamette to Pedee Creek; for water contact recreation (Fecal Coliform) from fall through spring.

- Rickreall Creek (Middle Willamette Subbasin) - Segment #22H-RICKO from the confluence with the Willamette to Mercer Reservoir; for flow modification and stream temperature (summer).

The DEQ's 1996 303(d) report also identified each of the following streams in the analysis area as a "water body of concern." This list includes streams where a concern has been identified, but there are not enough data either to place the stream on the 303(d) list or to remove it from the list of active concern. These streams will be investigated as time and data become available:

- Rickreall Creek: Mercer Reservoir to headwaters; for sediment.

- Rockhouse Creek: mouth to headwaters; for sediment.

- Little Luckiamute River: mouth to headwaters; for flow modification and sediment.

- Luckiamute River: mouth to headwaters; for sediment.

- Pedee Creek: mouth to headwaters; for flow modification

- Ritner Creek: mouth to headwaters; for sediment.

- Gooseneck Creek: mouth to headwaters; for flow modification and sediment

- Mill Creek: mouth to headwaters; for habitat and flow modification and sediment.

There are three municipal watersheds in the analysis area:

1. Dallas - Draws surface water directly from Rickreall Creek for treatment. The Mercer Reservoir provides regulated flow for summer diversions by the City of Dallas and agricultural users.

2. Falls City - Draws surface water for treatment from Teal Creek and Camp Kilowan Spring.

3. Monmouth - Draws surface water for treatment from Teal Creek.

Current data imply that water quality in the Analysis Area is, with some notable exceptions, generally unacceptable and probably degraded from reference condition. Some of the weaknesses in the current data include:

- little or no data are available for most of the analysis area,
- current data are concentrated in the lower sections of main stems in the analysis area,
- followup data establishing trends for parameters of concern are unavailable, and
- April 9, 1998, major data gaps exist for parameters of concern to fisheries and aquatic species (i.e., stream temperature and dissolved oxygen concentrations during baseflow).

These major gaps in knowledge mean that current assessments of conditions are strictly preliminary. The little data that are available indicate that WQ conditions are degraded in much of the Mill Creek mainstem and its perennial tributaries, particularly during the summer when a combination of reduced baseflow, and heavy use and withdrawal of available water coincide (see "Hydrology: Current Conditions," p. R&CC-7). *Hypothetically*, deteriorated channel conditions in tributary streams are also contributing to degraded water quality, but because these tributaries are primarily on private agricultural lands, no measurements have been taken.

Sediment production, delivery to streams, and transport through streams is poorly quantified in general, and the subwatersheds in the analysis area are no exception. Sediment processes are understood in a generic sense, but site-specific data are not available, particularly for forested uplands. Although some sites of sediment delivery to upland streams from landslides and roads were identified in this report (see "Soils," p. R&CC-2), no measurements of quantities of sediment delivered or transported, scoured and deposited, or the infiltration of gravels by fine materials (sands, silts and clays) on forested streams managed by the BLM are available for this analysis.

This analysis identifies some of these sources and evaluates their potential for degradation of WQ and aquatic resources. The most likely sources of stream sediment include:

- stream bank and channel erosion,
- surface erosion off agricultural lands, and
- erosion from upland forested lands.

For this analysis, a qualitative inventory to evaluate potential for stream bank erosion in lowland and upland channels and an evaluation of potential sediment sources from forested upland sites were conducted only in the Mill Creek Subbasin. Surface erosion off agricultural lands, while likely to be a major source of stream sedimentation in the analysis area, was not evaluated.

One major source of stream sediment is likely to be bank erosion in streams that have incised in the alluvium at the base of the forested uplands. Many of these channels were altered as a result of land management practices earlier in the century (primarily through drainage structures for the establishment of agricultural crops) and have yet to stabilize (see "Stream Channels," p. R&CC-25).

To assess bank erosion potential, an informal survey was conducted in the Mill Creek subbasin (see Hawe 1997). Several sites where the channel was accessible from the road were evaluated employing criteria developed by Rosgen (1996). Conclusions from this assessment include:

- Channels in the forested uplands have low potential for bank erosion, primarily because the majority of these channels have no stream banks.

- Moderate bank erosion potential exists in response-type channels in the forested uplands, and sections of active bank erosion in these stream types were observed. The BLM manages very little of this stream type in the area.

- The Upper Mill Creek mainstem, from the forested uplands to the county park, has very low bank erosion potential: this channel is almost entirely a bedrock gorge and erodible banks are rare.

- Mill Creek main channel and its tributaries from the county park to the lower mainstem at Highway 18: the channel is deeply incised in alluvial material, and severe, active bank erosion was observed at several sites. A turbidity sample was taken in lower Gooseneck Creek (at Harmony Road) during a January, 1998, storm event. This sample had over 400 NTUs (NTUs measure turbidity as a function of light reflectance; for comparison, the federal standard for drinking water is less than 1), the highest turbidity level observed during four years of winter storm sampling. These lands are entirely privately owned.

The most likely active sources of sediment and organic material in the forested uplands portion of the analysis area include:

- landslides associated with steep hillslopes,
- fine sediments from road and trail surfaces, and
- surface ravel erosion from steep hillslopes immediately adjacent to channels.

Based on research results from other forests (Grant and Wolf 1991), it is generally true that past and current forest management activities have triggered hillslope failures near roads and clear-cuts, with delivery of sediment to streams in excess of that under reference condition. In the Upper Mill Creek and Rickreall watersheds in particular, these processes are clearly major sources of accelerated sediment delivery to streams (see "Soils," p. R&CC-2).

As indicated in the channel condition section of this report, perhaps the greatest impact of the accelerated sediment supply from landslides on steep ground in the forested sections of Mill Creek is channel instability in the lower sections of Mill Creek: it is likely that this material has contributed substantially to bank erosion, and therefore high turbidity levels, in the lower mainstem. In addition, this material aggravates channel widening and the destruction of stream banks and their vegetation, thus contributing to higher water temperatures during summer base flow. However, understanding precisely how this material effects WQ, channel conditions and aquatic habitat on a site-specific basis is complicated and would require a far more rigorous investigation and analysis.

Potential sources of accelerated sediment delivery to streams were identified during the BLM's 1997 summer road inventory of the analysis area; recommendations for treatment of these sources are listed under restoration opportunities. In addition, road segments on BLM lands will be evaluated for risk to WQ as one factor under the Transportation Management Plan objectives to be completed during subsequent analysis iterations.

High use, mainline haul roads adjacent to streams are likely to be a large contributor of fine sediment to streams in the analysis area. Once again, site-specific data are unavailable. However, informal observations of mainline haul roads during storm events showed that ditches along these roads route large quantities of turbid runoff directly to channels. In cases where the BLM manages road maintenance, these road segments will be a high priority for upgrading and improved drainage and sediment control.

As in much of the forested zone adjacent to the Willamette Valley, there is evidence of some off-highway vehicle (OHV) traffic on public lands throughout the analysis area. There is potential for WQ degradation as a result of heavy trail use during the winter. However, because the extent of OHV use in the analysis area is essentially unregulated and unmapped, its not possible to determine to what degree it is contributing to WQ degradation.

Surface erosion on forested uplands in humid areas is typically short-lived and relatively rare (see "Soils," p. R&CC-2). Delivery of substantial amounts of surface erosion sediment to streams normally occurs only with extensive site disturbances, such as fires, followed by large storm events. Therefore, the influence of surface erosion in forested uplands on WQ in the analysis area is likely to be relatively unimportant. The most recent extensive site disturbance was the Rockhouse Creek fire which burned to the stream along large portions of Upper Rickreall Creek. Data on sediment delivery to streams as a result of this fire were not located for this report.

Solar radiation is a principal factor controlling stream temperatures. Solar energy inputs to streams are affected by the quality and quantity of shade-producing vegetation, topography, season, flow, and channel form. Natural disturbance agents such as fire, windthrow, and storm-induced channel scour, and human activities such as timber harvest, road construction, and riparian-based recreation have the potential to influence stream temperature by altering streamside vegetation, summer baseflow regime, and channel form. Small, headwater streams are particularly at risk for increases in stream temperature as a result of disturbance. Dissolved oxygen concentration is linked to stream temperature, and together these two parameters are critical to the reproduction and survival of aquatic life.

Sources for stream temperature increases due to inadequate cover from adjacent riparian vegetation (i.e., potential "hot spots") are identified in the riparian vegetation section of this analysis. Stream temperatures may be monitored at those sites on BLM land to further evaluate and document conditions.

The BLM has continuous stream temperature data collected during the summer of 1997 at two sites on Mill Creek. These data are displayed in Figure III-7 (p. R&CC-35), and indicate that the upper site (a high-gradient tributary stream which drains mostly public lands) is fairly cool at baseflow and far below the state of Oregon upper limit for temperature. Under full forest cover, stream temperatures in small upland streams are adequate to support aquatic life and coldwater species in this analysis area.

Seven Day Maximums at the lower site (the BLM Recreation site just above the county park) were above the DEQ's standard (17.8 °C) for most of the monitoring period. Although 1997 was a relatively cool summer, temperatures at the lower site on Mill Creek are among the highest recorded in the Mary's Peak RA during five years of monitoring. Water temperature during summer base flow is clearly limiting to aquatic life and likely to be near, or beyond, the upper limit of the historic range. Streamside vegetation at this site, and at most sites in the analysis area (see "Riparian Reserves," p. R&CC-19) on public lands, is adequate for the maintenance of water temperatures within their historic range. However, it is likely that removal of streamside vegetation along large portions of the Mill Creek mainstem on private lands above this site made a significant contribution to warming. The Upper Mill Creek mainstem is particularly susceptible to warming by solar radiation due to the extensive basalt bedrock, and removal of the riparian canopy opens the stream to direct heating by the sun. Data collected in summer 1998 should corroborate this hypothesis.

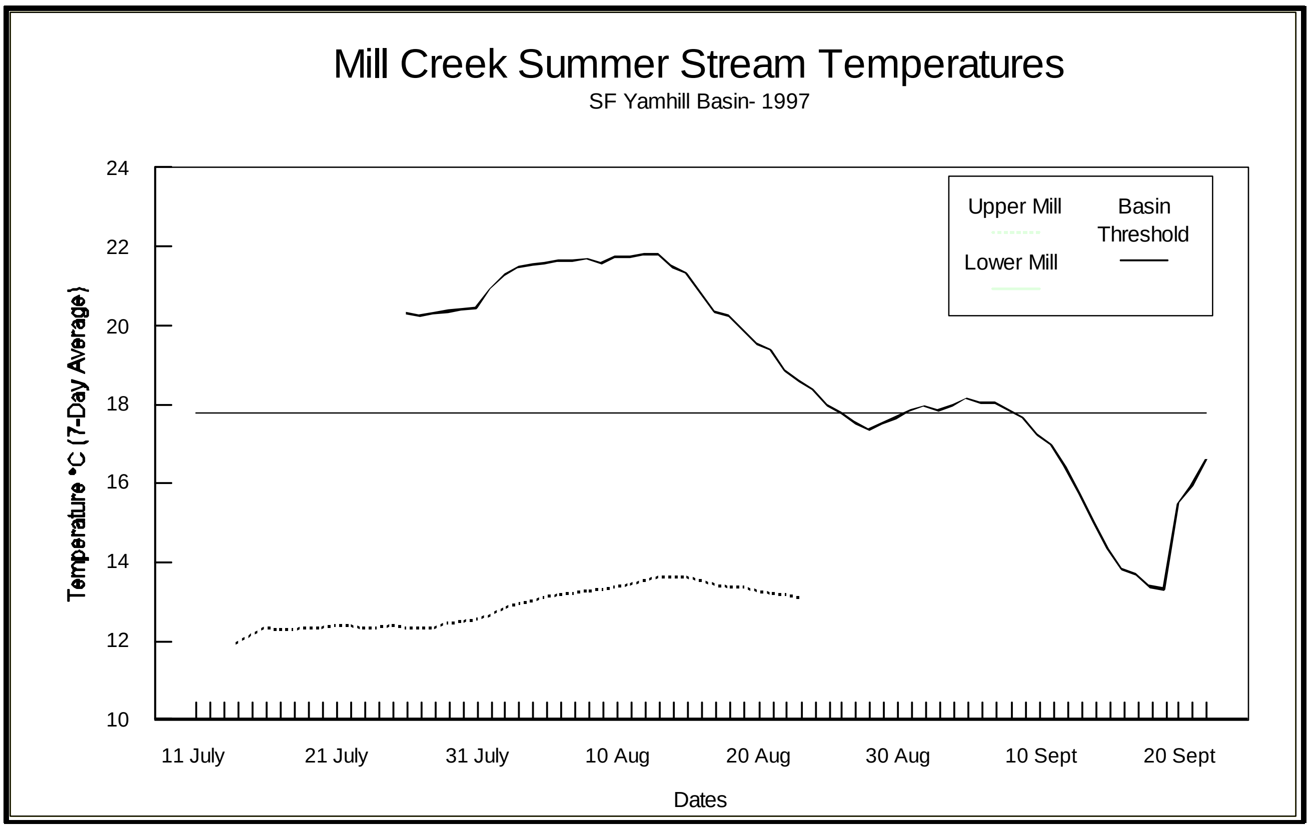

Figure III-7. Seven Day Maximum Stream Temperatures at Two Sites on Mill Creek, Summer 1997

Stream temperatures at lower elevations in the watershed have not been collected by the BLM at anytime (the BLM does not routinely collect WQ data on private lands). However, data from previous years in the lower mainstem led the DEQ to its current 303(d) listing of this stream as temperature limited. The lower mainstem is particularly susceptible to temperature elevation due to the poor channel condition (high width/depth ratio, etc.) and the lack of streamside vegetation. With the large quantity of heated water contributed by Upper Mill Creek, it is likely that lower mainstem temperatures were elevated far above the standard and may be incapable of supporting coldwater aquatic species during the late summer.

Dissolved oxygen (DO) data, particularly for upland forested sites, were not located for this analysis. Where stream temperatures exceed state standards, it is likely that levels of DO will be depressed, further stressing aquatic communities. In addition, heavy concentrations of organic materials, such as logging debris and hardwood leaf droppings in the fall, may cause local, short-term reductions in DO which can be lethal to salmonids. However, under current forest practice regulations, these conditions are unlikely to persist.

Concern over the potential for introduction of pathogenic micro-organisms to surface waters has risen in recent years, due in part to the increased human use associated with unmanaged, dispersed recreation occurring in riparian areas adjacent to urban zones as well as to livestock grazing in lower river valley reaches. In addition, forest management activities may be perceived as threatening to rural users of surface waters as a source of domestic water supply. This situation is particularly common at the urban/forest boundaries in the Willamette Valley foothills.

The existence or extent of water-borne disease contamination in surface waters of the forested uplands in the analysis area appears to be unknown; the BLM has not sampled for fecal coliform, giardia or other water-borne disease organisms. Nevertheless, giardia is considered an endemic species and is commonly found in beavers and even domestic dogs throughout the state. All surface waters utilized for domestic purposes should be disinfected and filtered. (Domestic water users may have their drinking water quality tested for a nominal fee by the Microbiology Department at Oregon State University, Corvallis.)

In addition to being listed as temperature limited, samples from Mill Creek were found to be above the state standard for coliform bacteria and have resulted in a listing for that as well. The source of this contamination has not been verified. Forest management, in and of itself, is not thought to influence the levels of pathogenic bacteria in streams. High levels of bacteria in forested areas will usually be associated with inadequate waste disposal by recreational users, presence of animals in the riparian zone, and septic systems (EPA 1991).

Dispersed camping and recreation occurs along stream banks in portions of the analysis area and may result in unsanitary disposal of human fecal matter in the riparian zone. Several sites on Mill Creek (public and private) appear to be heavily used during the summer and yet have no toilets. One site observed on the BLM in Upper Mill Creek in summer 1997 was littered with trash and clumps of used toilet paper within several feet of the stream. Bacterial contamination of streams may also result from elk and other wild animals, including beaver and deer. In addition, incidences of giardia and cryptosporidium contamination of surface and spring water have been reported in many Oregon streams.

A very brief discussion of additional WQ parameters which are potentially influenced by forest management follows:

! pH - No sampling has been conducted on public lands in this analysis area.

! Conductance - No data were located for this analysis. No standards have been established.

- ! Nitrogen and phosphorous - No data were located for this analysis. Forest management influence on these nutrients is primarily through aerial fertilization with urea and the introduction of fine sediments which provide surfaces to which these nutrients adhere.

- ! Herbicides and pesticides - WQ data for organic chemicals were not located for this analysis. Organic chemicals are not currently used on BLM lands but are known to be extensively applied on adjacent private forest lands and in lowland agricultural areas.

SPECIES & HABITATS

PLANT HABITAT: Reference Conditions

Special plant communities occurred in special habitats such as dry and wet meadows, wetlands, cliff and talus within the analysis area prior to 1850, but in an unknown amount and distribution. Ecological and physical processes produce special habitats within the forest. These processes include the following disturbance regimes: patch and gap dynamics; hydrological cycles; geomorphic and erosional processes; nutrient cycles; energy flows; biomass and resource productivity; vegetation mortality and regeneration rates; herbivory, parasitism, and predation rates; colonization and local extinction; and others. Special habitats indicate the potential health of special habitat-dependent species and are closely related to the continued existence of these species. The rate, location, extent and intensity of natural environmental stressors affected special habitats and could have made their status more, or less, secure. These stressors include fire frequency, intensity and spatial patterns, and climate change, insect epidemics, wind and floods.

PLANT HABITAT: Current Conditions

The ecological and physical processes that operated in the past to produce special habitats are presumed identical as those that currently produce these habitats (see above). In addition to the natural environmental stressors to special habitats listed above, more recent induced environmental stressors also affect special habitats. These stressors include: air and water pollution; exotic species; fire suppression strategies; road densities; extent and intensity of silvicultural treatments; habitat simplification; siltation; fragmentation and loss of habitat corridors; and secondary effects of restoration activities.

Within the megawatershed, there are four Areas of Critical and Environmental Concern (ACECs): three are located within the analysis area (Little Grass Mountain ACEC/ONA, Little Sink ACEC/RNA, Rickreall Ridge ACEC), and one is located outside of the analysis area (Forest Peak ACEC/RNA). All four have approved management plans [*Management Plans For (Areas of Critical Environmental Concern*), Salem District Office, August 2, 1997]. Note that while these areas are each designated as ACECs, two are designated additionally as Research Natural Areas (RNAs) and one is also designated as an Outstanding Natural Area (ONA). Descriptions of these designations are as follows:

Area of Critical Environmental Concern ("Federal Land Policy and Management Act of 1976")

ACECs are ". . . areas within the public lands where special management attention is required (when such areas are developed or used or where no development is required) to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources, or other natural systems or processes . . . ” (43 CFR 1601.0-5). To be designated an ACEC, the value, resource, system, or process identified must be of “substantial significance . . . this generally requires qualities of more than local significance and special worth, consequence, meaning, distinctiveness, or cause for concern.” (43 CFR 1610.7-2).

Outstanding Natural Area (43 CFR 2071.1, 1970; 43 CFR 1727.1, 1966)

ONAs are “... areas of outstanding scenic splendor, natural wonder, or scientific importance that merit special attention and care in management to insure their preservation in their natural condition. These usually are relatively undisturbed, representative of rare botanical, geological, or zoological characteristics of principal interest for scientific and research purposes.” (43 CFR 2071.1)

Research Natural Area (“Federal Land Policy and Management Act of 1976"; 43 CFR 8223)

The RNA designation has developed into a national inter-agency network of areas to be maintained for the primary purposes of research and education. Since the designation itself is not tied to a particular law, each agency uses different laws and regulations to govern its use. The “Federal Land Policy and Management Act of 1976" [102(a)(8)] states that Bureau lands are be managed in a manner that will protect scientific and environmental values, and preserve and protect certain public lands in their natural condition. Bureau regulations state that for an area to be designated as a RNA, it must have one or more of the following characteristics:

- A typical representation of a common plant or animal association
- An unusual plant or animal association
- A threatened or endangered plant or animal species
- A typical representation of common geologic, soil, or water features
- Outstanding or unusual geologic, soil, or water features

Below are the primary values used in determining the areas’ relevance and importance while designating them as ACECs and managing them as special areas. (Note: Information regarding management use restraints can be obtained from the District ACEC or the Marys Peak ACEC Coordinators.)

Forest Peak ACEC/RNA (T. 10 S., R. 5 W., sec. 29)

Primary Values: This area, on the Willamette Valley margin, consists of a mature Douglas-fir forest (the stand dates to 1870), with western hemlock and grand fir. A grassy bald is located at the northern boundary of the ACEC. The area includes one first- and one third-order stream subwatershed, both in the Soap Creek drainage.

Forest Peak fills an aquatic RNA cell (as defined in the Oregon Natural Heritage Plan [1988]) for a first- to third-order stream in the Willamette Valley margin. The area’s diverse terrestrial ecosystems are representative of pre-settlement valley margin systems and fill a gap in the continuum of natural areas along the valley margin, broadening the genetic representation of native, valley margin species and habitats. While the area is botanically interesting, it is not unique. However, *Cimicifuga elata* (tall bugbane) has been identified in the riparian area and is a BLM sensitive species. This species is usually found in and adjacent to the Willamette Valley margin and is usually associated with big-leaf maple and sword fern.

Forest Peak contains both terrestrial and aquatic natural systems and processes. These systems have received no purposeful manipulation and only minor disturbance from historic human activities. Forest Peak, in particular the grassy bald, may have originated as a result of Indian burning in the Willamette Valley. The area contains wildlife habitat important in maintaining species diversity.

An entire undisturbed subwatershed from first- to third-order streams is contained in the 95 acres of the ACEC. The third-order stream is short and may be ephemeral, but the cutbanks are three feet in depth. The small third-order stream segment may be the only undisturbed third-order stream known in the Willamette Valley. Forest Peak met an unfilled aquatic cell in the Oregon Natural Heritage Plan, Natural Heritage Advisory Council (1988). This valley margin subwatershed is rare and vulnerable to any change, and furthermore, it is irreplaceable since protectable, undisturbed land on the valley margin is rare. Because the subwatershed fits an identified cell, it has more than just local significance.

Management Objectives:

1. To maintain, protect or restore relevant and important values.

2. To preserve, protect or restore native species composition and ecological processes of biological communities. These areas will be available for short- or long-term scientific study, research and education, and will serve as a baseline against which human impacts on natural systems can be measured.

Little Grass Mountain ACEC/ONA (T. 9 S., R. 7 W., sec. 31)

Primary Values: The predominantly unmodified natural setting atop this 2,750-foot peak is noted for its open grass/fern bald complex, a feature found atop only a few peaks of Oregon's Coast Range. The complex has widely dispersed pockets of conifers within it and is bordered by conifer forest. The area is noted for its attractive spring and early summer vegetation colors and its stark visual contrasts of vegetation types. The summit provides excellent panoramic views of the Coast Range, Willamette Valley, and the Cascades.

Five main plant community types have been described:

(1) Open grass/forb meadow (*Carex rossii* [Ross's sedge] association).
(2) Rock balds in the meadow (*Lomatium martindalei* [few-fruited desert parsley] community).
(3) Brush thickets in the meadows.
(4) South-slope forest/outcrops.
(5) Forested north-facing rock cliffs.

Elk, mountain beaver, cougar, bear, and a variety of other wildlife live in or utilize the area.

Recreation activity opportunities in the ONA include hunting, day hiking, wildlife and plant observation, nature study, and scenic viewing. The area offers visitors the opportunity to experience some sense of isolation from the sights and sounds of human activity and a high degree of interaction with nature.

Management Objectives:

1. To maintain, protect, or restore relevant and important values of the area.
2. To provide for recreational uses and environmental education. Manage uses to prevent loss of the outstanding values.
3. Provide and maintain education opportunities in environmental education areas. Control uses to minimize disturbance of educational values.

Little Sink ACEC/RNA (T. 8 S., R. 6 W., sec. 33)

Primary Values: Little Sink ACEC is a low elevation Douglas-fir forest occupying an area of marine siltstone which has undergone considerable landsliding. The ACEC's primary values derive from its geological instability, which has produced slump benches, scarps, basins and ponds. Most of the ACEC is covered with hummocks. This varied topography supports great biotic diversity within a relatively small area, providing exceptional opportunities for community-level studies of its flora and fauna. A large portion of the ACEC is covered with old-growth Douglas-fir with mixtures of grand fir, red alder, Oregon maple, and vine maple. Many of the unusually large Douglas-fir trees lean, indicating that massive slumping has occurred because of the area's unstable substratum. A wide variety of plants cover the ground; ferns, Oregon grape, and salal are the most common. There are two perennial ponds within the ACEC, a third perennial pond on its western boundary, and many intermittent ponds. These ponds are in a transitional stage, filling up with organic debris preliminarily to forming bogs. Many animal species have been observed within the ACEC.

Management Objectives:

1. To maintain, protect, or restore relevant and important values.
2. To preserve, protect, or restore native species composition and ecological processes of biological communities. These areas will be available for short- or long-term scientific study, research and education which will serve as a baseline against which human impacts on natural systems can be measured.

Rickreall Ridge ACEC (T. 7 S., R. 7 W., secs. 27, 33 and 34)

Primary Values: Rickreall Ridge is particularly distinctive in supporting a wide diversity of plant species within a relatively small area. Several Willamette Valley species reach their upper elevational limits here, and typical Coast Range plants can also be found here. The area harbors some plants and animals that are more characteristic of southwestern Oregon, and it appears to be a disjunct refugium for species that had spread northward during a past warmer and drier climatic period. One moss species found on the ridge, an arctic/boreal species, has not been found anywhere else in the Oregon Coast Range.

Dr. D. V. McCorkle has studied six isolated and unique strains of butterflies within the ACEC and the unusual food/plant relationships upon which they depend for survival. Dr. J. M. Johnson has studied two populations of Indian paintbrush in an effort to relate their genetics to their ability to form pigments, and he and his students have studied a population of dwarf Oregon white oak on Rickreall Ridge which may be important as an indicator of past climatic events in the area.

Management objective:

1. To maintain, protect, or restore relevant and important values within the ACEC.

PLANT SPECIES: Reference Conditions

Information on actual plant species occurrence and population reference conditions and trends is lacking and can only be inferred from current conditions and trends. Mid- and late-successional species were probably more common than invasive early successional species in the coniferous forested uplands. In the lower elevation areas where oak savannahs may have been dominant, early successional and invasive species may have been more abundant than in the coniferous uplands.

PLANT SPECIES: Current Conditions

Within this analysis area, plant species of concern are defined as follows: Special Status Species (SSS) are listed, proposed and candidate species being reviewed under the Endangered Species Act, and/or sensitive, assessment, and tracking species identified by BLM policies; Special Attention Species (SAS) are identified in the *Salem District ROD/RMP*; and uncommon and special interest plant species are afforded protection under State of Oregon statutes.

There are several non-vascular plants (fungi, lichens, and bryophytes) that are considered SAS, and these species are protected by survey and manage guidelines identified the Northwest Forest Plan (1994; see Table C-3 in the ROD). A complete understanding of the current distribution is unavailable for many of these species. The following factors have contributed to our limited knowledge about these species within the analysis area:

- Survey and inventory have predominantly been limited to vascular plants.
- Surveys have historically been tied to proposed timber projects.
- Sightings are few and widespread for some species, indicating large gaps in range information.
- Only the most rudimentary of ecology data is available for many species; therefore, habitat requirements are essentially unknown for most of these species.
- Sighting location information is often general, lacking specific information to permit adequate follow-up surveys.
- Identification of some groups is difficult and can only be accomplished by a few individuals.
- Fungi species are often ephemeral.

There are no known Special Status Species occurring on BLM-administered lands within the analysis area. The following Special Attention Species are known to occur in the analysis area:

Lichens: *Lobaria oregana*, *L. linita*, *L. pulmonaria*, *L. scrobiculata*, *Nephroma helveticum*, *N. laevigatum*, *N. resupinatum*, *Peltigera pacifica*, *Pseudocyphellaria anomala*, *P. anthraspis*, *P. crocata*, *Sticta fuliginosa* and *S. limbata.*

Fungi: *Cantharellus cibarius*, *C. formosus*, *C. subalbidus*, *C. tubaeformis* and *Hydnum repandum.*

There are many other Special Attention Species suspected to occur within the analysis area. As species are discovered, they will be reported to the survey and manage data base.

The analysis area contains a few plant species that are considered uncommon and of special interest. Some of these species are protected under the Oregon Wildflower Law (State of Oregon 1963), which makes it unlawful to export or sell or offer for sale or transport certain plant species. Some of these species likely to occur in the analysis area include members of the following genera: *Calochortus*, *Calypso*, *Erythronium* and *Rhododendron*.

Certain invasive plant species, listed as "Noxious Weeds" by the Oregon Department of Agriculture (1994), are known to occur in the analysis area. They include Canada thistle (*Cirsium arvense*), bull thistle (*C. vulgare*), Scotch broom (*Cytisus scoparius*), St. Johnswort (*Hypericum perforatum*), and tansy ragwort (*Senecio jacobaea*). In addition to the above species, other noxious weeds known to occur within the analysis area are meadow knapweed (*Centaurea pratensis*), spotted knapweed (*C. maculosa*) and purple loosestrife (*Lythrum salicaria*).

These five species are all well established and widespread throughout the Marys Peak Resource Area as well as the entire Salem District. Eradication is not practical using any proposed treatment methods, but treatment emphasis is shifting toward the use of biological control agents. Populations primarily occur in disturbed areas such as roads and landings.

Both knapweeds are present in lesser amounts within the analysis area and mostly occur adjacent to right-of-ways. Purple loosestrife is documented within the analysis area and is increasing in aquatic and riparian systems. Treatment of these species is mainly mechanical (pulling) and with the use of biological control agents.

FISH HABITAT: Reference Conditions

Little is known about specific fish habitat conditions prior to 1850. Historically, a variety of natural processes such as fire, floods, landslides and windstorms, played a significant role in the development, maintenance, and modification of fish habitat conditions in the Oregon Coast Range. These natural processes have both positive and negative impacts on fish habitat and their conditions. Abundant logjams created by these same natural processes resulted in in-stream structure and dissipated flow, and coarse woody material probably trapped spawning gravel and created rearing pools, particularly in the lower gradient (less than 2 percent gradient) sections of the analysis area. However, these same processes created logjams that prohibited fish migration, produced sediment inputs that reduced the probability of egg survival, and caused high streamflows that would have prevented spawning.

Historically, portions of the analysis area have repeatedly burned. It is likely that coarse woody debris was common in streams before these fires, but it is also likely that coarse woody debris increased in streams following fire. Therefore, coarse woody debris was probably more persistent in the burned areas of the analysis area. Fires in the analysis area may have caused problems such as excessive sediment input, elevated water temperatures, lack of aquatic habitat for macro-invertebrates and loss of some riparian areas. Flooding can influence fish habitat by removing much of the coarse woody debris in and adjacent to the stream system. On the other hand, landslides and windstorms probably introduced large amounts of wood and sediment into streams.

FISH HABITAT: Current Conditions

All of the natural processes (fire, floods, landslides, and windstorms) that influenced the development, maintenance, and modification of fish habitat conditions in the Oregon Coast Range in the past still play a significant role today. However, in addition to these natural processes, fish habitat in the megawatershed area has also been altered substantially since Euro-American settlers arrived. Many developments such as home sites, agriculture, and timber harvesting (splash dams, use of horses, oxen and mules, sawmills, steam donkeys, tractors, railroad logging and road building) have had significant impacts on fish habitat conditions.

Much of the valley bottom land and areas along the lower mainstem and the lower portions of the large tributaries have been cleared for pastures and home sites. These activities have substantially reduced the amount of active floodplain and have eliminated many of the productive flats, side channels, and seasonal refuge areas within the lower basin of the megawatershed. Changing the stream channel morphology and removing stream bank vegetation have increased channel scour, reduced bank stability, and increased sedimentation in these same areas. The number of large conifers that had the potential to fall into streams has been reduced substantially along most streams flowing through developed pasture lands.

A number of areas were cleared and developed as homesteads in the late 1800s and early 1900s. While concentrated in flat valley bottom areas, these sites were distributed throughout the valley and often extended up into the headwaters and tributary streams. The initial clearing eliminated almost all of the large conifers which had a potential to fall into streams in these areas. Many of these homesteads failed and were abandoned, and without management or replanting, most of this abandoned farmland has become thick alder stands or brush patches. The dense alder canopies which now exist preclude the establishment or growth of the new conifers which might provide future sources of persistent coarse woody debris for adjacent streams.

Roads have been constructed throughout the megawatershed area. In addition to increasing sediment and altering the drainage network, the presence of roads immediately adjacent to stream channels has substantially reduced the amount of riparian vegetation and the number of large conifers available to fall into streams.

The earliest logging methods used in the Pacific Northwest (1800s) involved jack screws and horses, oxen and mules, and probably had the least impact on fish habitat. The next major logging development that affected the analysis area was the steam donkey. Steam donkeys would usually be set up in a canyon or stream bottom, and the process may have removed all structure from the stream bottoms and decreased the amount of suitable habitat for fish. These methods may have caused landslides, large amounts sediment and the removal of in-stream structure. Railroad logging followed the steam donkey in some parts of the analysis area. In some cases a steam donkey may have gone ahead of the railroad construction operation. Lastly, there were road building and tractor operations on the hillslopes and on the stream banks that caused the same types of fish habitat problems as the other, previous activities. Road/stream crossings and poorly designed road locations resulted in increased stream sedimentation, slope failures, and stream diversions.

The use of splash dams to move logs down stream to mills during the time from the late 1800s until the early 1900s had one of the greatest impacts to fish and their habitat. There were approximately 180-220 splash dams constructed in the analysis area. About 80-100 splash dams operated on the Luckiamute River, 40-50 operated on Rickreall Creek, and 70 operated on Mill Creek (Moser and Farnell 1981; Sedell and Luchessa 1982). Splash dams were constructed to transport logs downstream during all flow levels. It is not known how much use these dams received during their operation, but it is believed that splash damming in general occurred for a period of approximately 27 years (" Splash Dams Operating on Western Oregon Rivers from 1880-1910" by Farnell. In Sedell and Luchessa 1982).

Splash dam operations usually caused extensive channel simplification and degradation of fish habitat through the disruption of riparian vegetation and the removal of gravels and in-stream structure in the

Luckiamute River and Rickreall and Mill creeks. Substantial changes which occurred during splash damming activities included stream widening, stream bank scouring, and the removal of trees, logs and boulders in order to prevent logjams during the drives (Sedell and Luchessa 1982). It is thought that splash dams had a greater impact on fish habitat than natural floods because splash dams were repeated time after time during the year, and thus, in-stream structure was removed at a much greater frequency than during a 10, 50, or 100 year flood event.

The following analysis of habitat conditions by subwatersheds was mostly office-based, using surveys conducted by the BLM in 1997 on 13.9 miles of streams on BLM-managed land. Historical fish data were taken mostly from two reports, the *Main Stem Willamette Fish Management Plan* and the *Coast Range Sub-basin Fish Management Plan* (ODFW 1992b and 1992a, respectively). The aquatic habitat ratings in Table III-10 (p. R&CC-49) are based on the National Marine Fisheries Service (NMFS) modified matrix, "Factors and Indicators for the Tyee Sandstone Physiographic Area, Oregon Coast Range Province." (NMFS 1997) All measures apply to "broad valley floor" reaches (gradient of 4 percent or less; Rosgen type C channel), and primarily to third- and fourth-order streams. Prior to any major activities in this analysis area, site-specific data are necessary.

Most stream reaches in forested areas of the Pacific Northwest encompass a variety of channel features that include different types of riffles and pools. Each of these features, in turn, provides habitat values for different fish species during different stages in their life histories. The identification and measurement of habitat units have become important for quantifying fish habitat and identifying limiting factors for their populations (e.g., Bisson et al. 1982; Hankin and Reeves 1988).

Aquatic habitat will be characterized based on the following elements that are critical to at least one life-stage of most aquatic species (See Table III-8, p. R&CC-47).

! Condition of streambed substrates
! Abundance of coarse woody debris (CWD) in stream channels
! Area and quality of pools at summer flows

Little Luckiamute River Subwatershed

The streams surveyed in this subwatershed were found to have an adequate number of pools and an adequate amount of deep pools, but lacked pools with cover or structure in them. The amount of coarse woody debris is considered to be slightly lower than acceptable. The dominant substrates are bedrock, boulder and cobble.

The Luckiamute River section that was surveyed (T. 8 W., R. 7 S., sec. 23) has a large logjam just below a clear cut on private land. This jam contains several large key pieces of wood and continues to catch smaller pieces. Teal Creek (T. 8 W., R. 6 S., sec. 31) has a large waterfall (30 ft.) with a large pool at the bottom which is used by the public for fishing and swimming. There is an old stringer bridge on Teal Creek, nine logs high, which is falling apart slowly, but gravels are being held back; below this bridge, the substrate is mostly bedrock.

Mill Creek Subwatershed

Streams in this subwatershed are in poor condition relative to fish habitat. Most streams in this subwatershed do not have enough deep pools with cover where fish can take refuge from predators or the flow of the stream. Coarse woody debris which can be used for providing structure in the channel to scour pools and provide cover is not abundant in this subwatershed. In many of the upper reaches, too much material (from the riparian areas) is being held back by coarse woody debris; as a result, channels and pools have filled in, causing the stream to spread out. However, over time this material will be transported out of the system.

Clayton/Pedee Creeks Subwatershed

Streams surveyed in this subwatershed have a low number of pools, and few of these had any complexity; further, none of the pools was deeper than one meter. Substrates are mostly cobble and gravel, but also have a high amount of silt. The two headwater streams of Pedee (tributaries 1 and 2 of Pedee, T. 9 W., R. 7 S., sec. 11) that were surveyed both had small, flat reaches, created by several old beaver dams, that have been stabilized by vegetation. These dams hold back large amounts of silt. Many snags are still standing that have been girdled by beavers, but there is no evidence of any recent beaver activity. Both of these reaches are swampy and have braided channels in them. Pedee Creek (T. 9 W., R. 7 S., sec. 13) has a culvert at which the majority of the flow goes *under* the culvert, through the substrate. However, fish were observed above this culvert.

Upper Luckiamute River Subwatershed

This subwatershed has a very low number of pools, with fewer still having any complexity or depth. There is also a low volume of coarse woody debris available as structure in the stream to scour pools, provide cover and hold gravel and cobbles.

A tributary to Boulder Creek (T. 9 W., R. 7 S., sec. 15) has a dysfunctional culvert — water flows through a logjam and the culvert is 3–4 feet above the stream flow and 10 feet away from the channel. Fish were observed above this culvert, which District engineers have scheduled to repair.

Upper Rickreall Creek Subwatershed

Streams in this subwatershed are high gradient streams with large amounts of bedrock and boulders. Although the basin appears to have a relatively high proportion of deep pools, this is misleading because of the high number of deep pools in tributary 4, South Fork Rickreall: this stream has waterfall after waterfall plunging into deep bedrock and boulder pools. The complexity of pools is also low. Coarse woody debris is not present in large quantities to provide structure, cover, or to hold back gravels and cobbles.

Table III-8. ODF&W Stream Condition Survey Data for Selected BLM Managed Lands In The Analysis Area

Subwatershed Name	Dominant Substrate	Complex Pools (%)	CWD (pieces/ mile)	Pool Area (%)	Total Reach Area (m^2)	Total Length (m)
Clayton/ Pedee	gravel/ cobble	28.6	53.9	5.6	9,676	4,124
Little Lucki-amute	bedrock/ cobble	7.5	54.9	25.4	11,787	1,715
Mill	cobble/ gravel	0.2	49.5	16.9	18,676	8,822
Lower Rickreall	No data are available for these subwatersheds.					
Rowell						
Upper Luckia-mute	cobble/ gravel	0.8	22.8	16.4	17,133	3,989
Upper Rickreall	bedrock /cobble	10.3	44.7	16.7	25,331	5,847

This table reflects the conditions of streams on BLM lands that were surveyed using ODFW methodology. All of the stream reaches surveyed were in transport/source reaches (see "Stream Channels," p. R&CC-25).

Coarse woody debris (CWD), substrates, pools, and off-channel habitat interact with disturbances and the valley form to create aquatic habitats. Properly functioning habitat sustains a diverse community of aquatic and riparian species. In contrast, habitat that is not functioning properly lacks adequate habitat elements or processes to sustain aquatic plants or animals at one or more life stages. Some stream reaches or entire subwatersheds may not be functioning properly compared to reference conditions due to disturbances such as wildfires or debris torrents. However, it is believed that in the analysis area, the reference condition would have been dominated by functional habitat as described in Table III-9, p. R&CC-48. Table III-9 contains the criteria by which habitat conditions were evaluated; the habitat ratings which are tabulated in Table III-10 (p. R&CC-49) are based upon the data given in Table III-8 (p. R&CC-47).

Table III-9. Stream Habitat Condition Factors

Stream Habitat Factors	Properly Functioning	At Risk	Not Properly Functioning
Stream substrate	Dominant substrates are gravel and cobble with very little fine sediment.	Gravel and cobble are subdominant substrates or embedded with moderate amounts of fine sediment.	Sand, silt or bedrock substrates are dominant, or mostly gravel and cobble substrates embedded with fine sediments.
Stream temperature	7-day average of daily maximum temperatures does not exceed 15.5 EC	7-day average of daily maximum temperatures between 15.5 and 17.8 EC	7-day average of daily maximum temperatures exceeds 17.8 EC
% of area in pools in: **1. Depositional flat reaches** **2. Deposition reaches** **3. Transport/source reaches**	 >55% >40% >30%	 40-55% 30-40% 20-30%	 <40% <30% <20%
Percentage of pools that are complex *	>20%	10-20%	<10%
Winter rearing habitat	Abundant beaver dams, damned pools, or off-channel habitats	NA	Habitat types are infrequent
Coarse Woody Debris pieces per miles **	>80	30-80	<30

This table shows reference conditions for selected life-stage habitats or indicators of salmon and trout (based on NFP 1994, NMFS 1995, and DEQ 1996).
* Complex pools are >3 feet deep in streams >10 feet wide or 1.5 feet deep in streams < 10 feet wide, and have woody debris cover > 60 percent, plus 3 pieces of coarse woody debris or ODFW wood rating > 4.
** Woody debris is > 24 inches in diameter and 50 feet long.

Table III-10. Stream Habitat Condition Ratings for Selected BLM Reaches by Subwatershed Within the Analysis Area

Subwatershed Name	Sub-strate	CWD	Pool Area	Pool Quality	Channel Condition
Clayton/Pedee	PF	R	N	R	R
Mill	PF	R	N	N	R
Upper Rickreall	R	R	N	R	R
Little Luckiamute	N	R	N	N	N
Upper Luckiamute	PF	N	N	N	N

Habitat Ratings: FP = Functioning properly; R = At risk; N = Not functioning properly (See also Table III-9, p. R&CC-48) Note: No data have been collected for any of these streams for temperature, barriers or off-channel conditions. No data on any of these condition ratings are available for Lower Rickreall or Rowell creeks.

FISH SPECIES: Reference Conditions

Prior to settlement of the Willamette Valley by Euro-Americans (around 1850), Native Americans harvested resident fish as a food source as well as for other traditional or ceremonial uses. Perhaps the fish populations were influenced by these uses, but nothing is known specifically about species presence or fish population condition prior to Euro-American settlement in the megawatershed area.

FISH SPECIES: Current Conditions

All of the natural and human processes listed above in the fish habitat reference and current conditions section will play a significant role in fish species' presence, and population conditions and trends since habitat conditions directly affect fish survival and reproductive success. Data indicate that species such as chinook salmon (*Onchorhynchus tshawytscha*) and winter steelhead (*O. mykiss*) are the principal anadromous fish species present in the Willamette River. Other fish present in the analysis area include cutthroat trout, summer steelhead, rainbow trout, coho, and such introduced warmwater game fish as smallmouth, largemouth and warmouth bass, white crappie, bluegill, pumpkinseed and brown bullheads (see Table III-11, below). Because of limitations of staff and equipment, it is difficult to obtain a representative sample or an accurate estimate of the populations or distributions for fish within BLM-managed lands, but it is believed that native fish such as trout reside in most of the streams throughout the analysis area. There are no known data pertaining to populations of these resident fish. However, it is believed that many second-order, and all third-order streams (i.e., those having gradients less than 8 percent) and below have fish present.

Table III-11. Stream and Fish Presence Miles by Subwatershed in the Analysis Area

Subwatershed	Total Stream Miles	Inter-mittent Miles	Peren-nial Miles	Un-known Miles	Fish Miles	Anadro-mous Miles	BLM Anad. Miles	BLM Resident Miles
Clayton/Pedee	181.3	87.3	84.6	9.4	70.5	10.0	.2	8.4
Little Luckiamute	361.2	179.3	170.9	11.0	149.9	9.4	0.4	4.1
Mill	336.7	165.3	134.9	36.5	86.2	10.4	0.0	24.1
Lower Rickreall	119.2	62.4	51.6	5.2	39.4	8.5	0.0	1.9
Rowell	82.1	22.7	50.2	9.2	33.7	0.0	0.0	7.9
Upper Luckiamute	239.3	106.8	106.7	25.8	82.5	19.4	1.1	5.3
Upper Rickreall	165.8	86.9	62.5	16.4	37.2	0.0	0.0	6.2
Total Miles	1485.6	710.7	661.4	114	499.4	57.7	1.7	57.9

Data derived from BLM GIS analysis; confidence in data is based on the limitations of such analysis.

Historical records show that the Oregon chub (*Oregonichthys crameri*) was found in the Little Luckiamute River (Markle et al.1990). The Oregon chub has been listed as endangered under the Federal Endangered Species Act (ESA) since 1993 (it is not listed under the Oregon Endangered Species Act). Currently, there are no known Oregon chub in the Little Luckiamute River or any streams in the analysis area.

Historically, only spring chinook salmon (*Oncorhynchus tshawytscha*) and winter steelhead trout (*O. mykiss*) could migrate over Willamette Falls into the Upper Willamette Valley. Spring chinook are the only race of salmon native to the Willamette River system above Willamette Falls (ODFW 1992b). Most of the spring chinook (about 70 percent of the 1970 run) were believed to be of hatchery origin (Bennett 1988). Hatchery spring chinook were released into the mainstem Willamette above Willamette Falls during 1977 and 1982-1987, but it is assumed that spring chinook no longer exist in the analysis area.

The native Willamette winter steelhead is a late-returning stock, but all winter steelhead stocks are proposed for listing under the ESA, with the determination due February 1999. There are no hatcheries which produce winter steelhead on the mainstem Willamette River, and no hatchery releases of winter steelhead occur in the mainstem. However, there were releases of winter steelhead into the Coast Range subbasin during the years 1964 though 1987, and some of these releases were throughout the megawatershed. Winter steelhead harvest in the upper mainstem Willamette occurs between Salem and Independence. From 1976 through 1988, the average annual sport catch of winter steelhead in the mainstem above Willamette Falls was 216 fish. Recently, Rickreall Creek has provided the majority of the steelhead harvest (ODFW 1992b). Steelhead production has been documented in the Luckiamute and Little Luckiamute Rivers, but additional spawning areas of winter steelhead are suspected in the Little Luckiamute, Teal Creek, and Pedee Creek.

Cutthroat trout are native to the Coast Range, and are currently listed as a stock of concern due to the insufficient information regarding their status. These trout are widely distributed in the analysis area and occur at least seasonally in most perennial streams. Isolated populations of cutthroat trout occur above barriers in Mill Creek, South Fork Yamhill River, and Rickreall and Teal creeks, and the Luckiamute system.

Summer steelhead are not native to the Willamette Sub-basin. From 1965 through 1973, steelhead were released into the Yamhill, Rickreall and Luckiamute systems; they were also introduced into several tributaries during the late 1960s. Natural production of these introduced summer steelhead is considered undesirable since the potential exists for negative interactions with native Willamette winter steelhead. Summer steelhead in the Willamette basin are managed for production and harvest of hatchery fish (ODFW 1992b). During 1977 through 1988, anglers were estimated to have harvested an annual average of 136 adult summer steelhead above Willamette Falls. The catch was generally higher during the latter part of this time period (averaging 250 fish during 1984-88), probably the result of an expanded hatchery release program in Willamette tributary streams and strong run sizes (ODFW 1992b).

Rainbow trout (*Oncorhynchus mykiss*) are not native to the Coast Range, but hatcheries began releasing rainbow trout as early as 1920s and 1930s in Yamhill, Rickreall Creek, and Luckiamute River. Catchable rainbow trout were released from 1976 through 1989 in Rickreall Creek, Little Luckiamute River, Luckiamute River, and Mill Creek (ODFW 1992b).

Fall chinook are not native to the sub-basin, but were released into the Luckiamute and Little Luckiamute rivers in 1974 and 1976. Natural production did not occur, so fall chinook do not occur in the sub-basin today.

Coho salmon are not native to the Willamette basin above Willamette Falls, but they were introduced above the Falls in the 1920s. Coho were found in the Luckiamute River system prior to 1955 before any releases were made directly into that system (Willis et al.1960). Unconfirmed reports of coho in Rickreall Creek were also made prior to stocking of the system (Willis et al.1960). Coho were released into the Coast Range from 1954-1988, including the analysis area. (Williams 1983, ODFW unpublished data). The exact distribution of coho in the Coast Range is not known, but is presumed to extend only to those areas that have been stocked since 1983. Suspected spawning areas for coho in the analysis area are the Luckiamute River, and Mill, Gooseneck, Gold, Rickreall, Pedee, Teal, Ritner, Casper and Rowell creeks.

Warmwater gamefish are not native to the Oregon Coast Range. There is no documentation of the initial introductions of warmwater game fish in the analysis area, but largemouth bass and panfish have existed in the Willamette basin since the late 1800s. Largemouth and smallmouth bass, black and white crappie, bluegill, pumpkinseed, warmouth, yellow perch, and brown bullheads are all found in the lower reaches of the Yamhill and Luckiamute rivers, and in a slough near the mouth of Rickreall Creek. Non-fish aquatic game species such as the bullfrog (non-native) and crayfish are also present in the analysis area.

WILDLIFE HABITAT: Reference Conditions

In this analysis, wildlife habitat will be described using landscape ecology terms. Landscape patterns are commonly defined by the presence of the following three elements: matrix, patches, and corridors (Forman

& Godron 1986). Matrix vegetation is primarily a function of regional climate, soil, and topographic interrelationships. Patches, either disturbance or remnant, are primarily the result of natural agents such as fire, wind and water. Streams and riparian zones define the corridor element in the analysis area.

Historically, the analysis area most likely had a matrix of late-seral/old-growth (LSOG; 80+ years old) forest habitat consisting primarily of Douglas-fir and/or western hemlock, with western redcedar in the wettest areas. Matrix habitat dominated the landscape and provided large areas of interior LSOG habitat. Connectivity (ease of movement through the landscape) was high since edge habitat was low and high contrast edge habitat (LSOG adjacent to early-seral habitat) was minimal.

Low density, large patch habitat resulted from infrequent large fires burning in the matrix; these large disturbance patches provided early (0-39 years) and mid- (40-79 years) seral habitat dominated by Douglas-fir. More numerous but much smaller unburned remnant patches of the oldest forests in the analysis area occurred in the wettest, most protected areas. These stands were probably dominated by western hemlock and western redcedar. A moderate density of small disturbance patches could be found scattered and bunched, both temporally and spatially, throughout the analysis area as a result of spot fires, wind, flood, soil movement, disease, and insect damage.

An extensive network of streams and associated riparian vegetation defined the primary corridor elements in the reference forest condition and provided an additional degree of connectivity throughout the analysis area. At lower elevations, these stream corridors were at their widest and wettest, and were probably dominated by older stands of mixed conifer and hardwood forests, while upper elevation riparian zones were drier, narrower, and more likely to burn during a fire event. A secondary corridor system existed as a network of big game and American Indian trails. These "roads" were probably used for hunting, food gathering, and as travel routes connecting the coast and interior valleys.

Within the forest ecosystem, Special Habitats (caves, cliffs, talus, wetlands, etc.) and Special Habitat Components (large snags, coarse woody debris, remnant wolf trees, etc.) are important breeding and foraging areas for many wildlife species. The current quantity and quality of naturally occurring Special Habitats (excluding man-made habitats such as reservoirs, mine shafts, excavation cliffs, etc.) should reflect reference conditions since special habitats are usually the results of local geomorphological features and are not generally impacted by typical forest management practices because they are usually not productive sites for growing trees.

Special Habitat Components develop and are sustained in LSOG forests. Fire and wind events occurring in these older forest habitats are known to leave individual live trees and large amounts of dead standing and down coarse woody debris scattered throughout the disturbance area. As new forest regenerated, a legacy of old-growth remnants, large snags, and coarse woody material provided special habitat components throughout the early and mid-successional stages.

WILDLIFE HABITAT: Current Conditions

Euro-American settlers put an end to Kalapuyan burning in the Willamette Valley around 1850, but the potential for human-caused fires in the forests of the Coast Range increased due to the intensity and carelessness of its use by the settlers themselves. Timber harvesting replaced fire as the main forest disturbance event somewhere between 1910 and 1940. As timber values increased, fire suppression and prevention efforts intensified to protect the resource and put an end to catastrophic fires. Access to and within the analysis area increased significantly from this time on as railroad lines and logging trails/roads were cut in.

Under reference conditions, lands in the analysis area were owned (based on current definitions of "ownership") by no person, family, people, group, or company. Today the analysis area is fragmented by four major, five 'minor,' independent landowners, and numerous smaller, privately-owned parcels (see Map 3, p. C-4). The majority of land, 80% (113,437 ac.), is owned by private timber companies and managed for timber production. Forests under private ownership are typically harvested during the mid-seral stage (40-79 years) of forest successional development. Oregon State Department of Forestry regulations provide protection to forest soil and water resources and require reforestation, but landowners manage their lands in differing ways, thus creating a patchwork of differently aged stands, usually cut along straight lines. Only 18% (25,956 ac.) of the lands in the analysis area are controlled by the BLM. Under the Northwest Forest Plan and *Salem District ROD/RMP*, all of the BLM lands in the analysis area are designated as Late-Successional Reserve and/or Adaptive Management Area. These allocations are designed to provide suitable habitat for late-seral and old-growth dependent species by managing ecosystems to protect, maintain or enhance late-seral and old-growth forests and their characteristics.

Under the current conditions of land ownership and usage, the landscape has lost its matrix component and is primarily dominated by a conglomeration of forest patches representing a wide range of size and age classes. With the absence of a matrix, which usually provides a significant amount of connectivity, the corridor component of streams, riparian zones, and roads now provides the only connectivity between patches. The analysis area is well roaded at this time, averaging 4.1 miles per section (current data underestimate miles on private lands). A mile of road, using 30 feet as an average width, converts about 3.6 acres of forest habitat; thus, about 15 acres of habitat per 640 acres of forest has been lost to roads in the analysis area.

For wildlife management purposes, the analysis area has been stratified by seral stage and age-class into the following six habitat types (see Map MP-3):

Conifer Early-seral (0-39 yrs)	**48%** (68,413 ac.)
Conifer Mid-seral (40-79)	**45%** (64,660 ac.)
Conifer Late-seral (80-199)	**01%** (883 ac.)
Conifer Old-growth (200^{+})	**03%** (4004 ac.)
Hardwoods	**03%** (3933 ac.)
Special Habitats	**See below**

Special habitats such as caves, cliffs, meadows, and wetlands are sites within the forest environment that provide unique breeding and/or foraging opportunities for wildlife. There are no known caves or significant talus deposits on BLM lands in the analysis area. Cliff habitat is limited in quantity and quality; most of the existing cliffs appear not to be high enough to provide the secure nesting habitat that cliff dwelling species prefer. Wetlands are scattered throughout the analysis area and range in number and size from a large man-made reservoir to many small slump and beaver ponds. A broad-scale inventory of special habitats has been completed on BLM lands in the analysis area, and there are approximately 2,641 acres scattered throughout the five habitat types listed above.

Forest management practices such as clearcutting, salvage logging, hazard tree removal, and slash burning have caused in a significant decline from reference conditions in the quality and quantity of special habitat components. Consequently, the complexity of horizontal and vertical structure has been greatly diminished.

WILDLIFE SPECIES: Reference Conditions

Information on actual species' occurrence and population conditions and trends is lacking and can only be inferred from landscape-level habitat conditions and trends. Species requiring a late-seral/old-growth forest matrix, interior forest habitat, special habitat components associated with LSOG forests (large diameter green trees, large snags, or coarse woody debris) and/or some large patches of early and mid-seral forests were probably common in the analysis area. Species preferring an early or mid-seral matrix, edge habitat, high-contrast edges, or patches of different seral stages in close proximity were not as common.

WILDLIFE SPECIES: Current Conditions

The numbers of terrestrial vertebrate species expected to occur in the forests of the analysis area are as follows:

Birds: 116 native, 4 introduced
Mammals: 58 native, 5 introduced
Amphibians: 13 native, 1 introduced
Reptiles: 10 native.

Refer to the *Atlas of Oregon Wildlife* (Csuti et al. 1997) and Oregon Department of Fish and Wildlife publication, *Oregon Wildlife Diversity Plan* (ODFW 1993), for a complete list of all species occurring in different habitat types in the Oregon Coast Range. Those species which prefer early and mid-seral habitats are expected to have stable populations. Species which use LSOG special habitat components, regardless of seral stage, and species which prefer late-seral and old-growth habitats may have unstable populations.

"Special status species" are species of concern because their populations are considered to be the most unstable over all, or part, of their range, due primarily to modification or loss of preferred nesting and/or foraging habitat (see Appendix VI for a complete list of special status species and their designations in the Marys Peak Resource Area). Concern is usually inferred from past, present, and expected future habitat conditions because little is usually known about the life history details of most of these species, thus making it very difficult to determine their population conditions and trends. The special status species listed below have met the following criteria: 1) their current geographic range includes all or part of the analysis area (extirpated species not included); 2) the analysis area has the potential to provide enough suitable nesting and/or foraging habitat to sustain viable populations or make a significant contribution to recovery; and 3) the species is known to occur, or sufficient information exists on life history and preferred nesting and foraging habitats to suspect species presence.

Invertebrates

Oregon Giant Earthworm (*Driloleirus macelfreshi*)
Oregon Megomphix Snail (*Megomphix hemphilli*)
Blue-gray Tail-dropper Slug (*Prophysaon coeruleum*)
Papillose Tail-dropper Slug (*Prophysaon dubium*)

The Oregon giant earthworm, which can grow up to three feet long, prefers deep, undisturbed soils, which are usually the oldest soil types in a watershed. There are no known sites in the analysis area; however, the closest known specimens have been found along the lower reaches of the Luckiamute River in Section 13 of T. 9 S., R. 5 W. There are no identification keys (several giant earthworm species occur in the area) or survey protocols available for this worm.

Habitat for the three mollusks occurs in damp areas under the forest canopy within the analysis area. The two tail-droppers can be found at or below the soil surface on rocks, vegetation or down wood. The Oregon megomphix snail is associated with big-leaf maples and can be found under fallen leaves not far from the base of this deciduous tree. Although there are no known sites in the analysis area for any of these three mollusks, all three are expected to occur. Survey protocols are now available for all three species, and surveys will be conducted for any future ground disturbing activities on BLM lands in the analysis area.

Amphibians

All of the amphibians native to the northern Oregon Coast Range, except for the extirpated spotted frog, are known to occur in the analysis area. Most are aquatic/semi-aquatic species and are closely associated with perennial waters and riparian zones. A few terrestrial species can occur far from water and are commonly found in and around coarse down woody material.

Reptiles

The sharptail snake (*Contia tenuis*) has a patchy distribution and is expected to occur at low elevations, in moist habitats, in the forests of the analysis area, especially within riparian zones. This snake may prefer LSOG forests but has also been found in younger stands. There are no known sites in the analysis area, and survey protocols are not available. Further study is necessary to determine if habitat modification and loss is responsible for its disjunct distribution and rarity.

Birds

Northern Goshawk (*Accipiter gentilis*)
Bald Eagle (*Haliaeetus leucocephalus*)
Marbled Murrelet (*Brachyramphus marmoratus*)
Northern Spotted Owl (*Strix occidentalis*)

The only known nest sites (2) of northern goshawk in the Oregon Coast Range were discovered in 1995 on BLM lands in Lane County in mid-seral (40-79 years) conifer forest. It is believed that the hawk prefers LSOG forests for nesting habitat, and it is most commonly found there in the Cascades and Blue Mountains of Oregon.

There are no known nesting or foraging sites for bald eagles in the analysis area. Eagles may be seen flying through the area occasionally, especially during the winter months.

The analysis area lies completely within marbled murrelet Zone 1 (0-35 miles from the ocean), between 15 and 32 miles from the Pacific Ocean. The first survey for murrelets within the analysis area was completed in 1990; however, most of the suitable nesting habitat in the analysis area has not been surveyed to protocol. Murrelets have been detected at six different locations, three of which are occupied sites, and three others of which showed presence only.

Approximately 3 percent (old-growth type, 4,000 acres) of the analysis area provides suitable nesting habitat for the murrelet. This old-growth nesting habitat exists as 115 stands scattered over the analysis area; the largest stand size is 304 acres, the average only 34 acres. Less than 1 percent (late-seral type, 882 acres) of the analysis area may provide additional nesting opportunities and is considered potential nesting habitat.

Northern spotted owl surveys began in 1975 on BLM lands in the analysis area. Yearly survival and reproductive success have been tracked over the last decade, with a consistent survey and banding effort. During the 1997 breeding season, 13 owl sites (10 on BLM and 3 on private) were surveyed in the analysis area. Owl pairs were found at 8 sites, single birds at 3 sites, and there were 2 unoccupied sites. Only three juveniles were produced in the analysis area during the 1997 breeding season. Low reproductive success for northern spotted owls is typical in this analysis area and is primarily due to the condition of nesting/foraging/roosting (NFR) and dispersal habitats. Suitable NFR (80+ year old conifer) habitat is in short supply, comprising only 4 percent (4,882 acres) of the analysis area. The quality of the NFR habitat is low due to its highly fragmented nature, resulting in small stand sizes with little or no interior forest habitat and lots of high contrast edge. Dispersal habitat (40+ years) covers 49 percent of the analysis area but is fragmented enough to increase travel times within the owl's median home range (MHR). Habitat conditions within the MHRs (all the land within a 1.5 mile radius of the site center) are poor since they all contain less than 30 percent NFR habitat.

Mammals

Fringed Myotis (*Myotis thysanodes*)
Long-eared Myotis (*Myotis evotis*)
Long-legged Myotis (*Myotis volans*)
Yuma Myotis (*Myotis yumanensis*)
Silver-haired Bat (*Lasionycteris noctivagans*)
Red Tree Vole (*Arborimus longicaudas*)
American Marten (*Martes americana*)

The fringed, Yuma and long-eared myotis require caves or cave-like structures (mine shafts, buildings, and bridges) for maternity roosts and hibernacula (winter roosts) (Christy and West 1993). These types of structure are uncommon in the analysis area, and these species are expected to occur in very low numbers. The long-legged myotis and the silver-haired bat may use cave-like structures for maternity roosts and hibernacula, but have also been found roosting under bark and in snags (Christy and West 1993). This type of habitat can be found in existing late-seral and old-growth patches in the analysis area. These species are expected to occur in greater numbers than the cavity dwelling species listed above. There are no known sites within the analysis area or survey protocols available for any of these species.

The red tree vole is expected to occur in its preferred habitat, the wettest late-seral and old-growth Douglas-fir stands in the analysis area. As an adult, this vole can spend its entire life in the canopy of a single LSOG fir tree. There are no known nest trees in the analysis area; however, a survey protocol and management guidelines are available for this species.

The American marten prefers LSOG forests but can be found in younger forests if they contain sufficient amounts of coarse down woody material. Populations are assumed to be on the decline throughout the Coast Range due to habitat loss, fragmentation, and loss of coarse down woody material. There are no known recent sightings of the marten in the analysis area, and there is no survey protocol available.

Big Game Species

Black Bear (*Ursus americanus*)
Black-tailed Deer (*Odocoileus hemionus*)
Cougar (*Felis concolor*)
Roosevelt Elk (*Cervus elaphus*)

Big game species are considered priority species (*Salem District ROD/RMP*) because the conditions and trends of their populations are considered to be socially and/or economically important to many Oregonians.

Elk, deer, black bear and cougar have populations that are either stable or increasing within the analysis area. For elk and deer, there is a need for maintaining well distributed (both temporally and spatially) foraging areas adjacent to hiding cover in the analysis area. Black bear and cougar numbers are expected to increase in western Oregon due to current hunting restrictions (no baiting or hounds allowed).

HUMAN USES: Reference Conditions

The Kalapuya Indians inhabited the megawatershed area during its earliest recorded history. The Yamhill bands of the Kalapuya occupied the area around Rickreall, Mill and Rowell creeks, and the Luckiamute bands resided on the Luckiamute drainages. The Kalapuya were primarily a valley tribe, living along the Willamette River and its major tributaries, and their use of the Coast Range was very limited, consisting primarily of occasional hunting and travel to trade with coastal people. A well-defined Indian trail linking the coast and the Willamette Valley ran along the Salmon River.

Since the Willamette Falls blocked most fish migrations into Willamette Valley streams, the Kalapuya did not have plentiful supplies of migrating salmon available. They relied instead on plant resources for food and products, and the most important plants were camas and tarweed. They also hunted deer and waterfowl. Two archaeological sites have been identified within the megawatershed; site artifacts consist of a quartzite knife and an obsidian projectile point.

HUMAN USES: Current Conditions

In the 1850s, Congress, through various homesteading laws, offered land to people who settled in Oregon. Many took advantage of the opportunity to get the free or inexpensive land, and as a result, the fertile valley lands of Rickreall Creek and the Little Luckiamute and Luckiamute rivers were quickly settled. Between 1854 and 1856, the government formed the Coast Indian Reservation and began moving the few remaining Kalapuya off the land and onto the reservation. In the north margin of the megawatershed, the Grand Ronde Reservation, established in 1857, prevented non-Indian settlers from making claims in that area until 1901, at which time certain reservation land was allotted to Indians and the remaining lands opened for settlement.

Settlers during the period from 1870 to 1920 were interested in agriculture. The valley homesteaders were numerous and quite successful in their farming endeavors. Timber was removed on the flat portions of the homestead tracts to make way for crops and livestock grazing. "Stump ranches" and "slash and burn farming" were terms commonly applied to this form of subsistence agriculture. Most of the homestead locations had only a few acres of cropland and a small area of slash and burn. Agriculture and livestock were the primary means of subsistence for residents in the megawatershed prior to the onset of logging. Settlers then focused on obtaining land in the higher elevations of the Coast Range, but many relinquished their holdings after they were unable to make a living off those more marginal lands. Early homesteaders used grassy balds in the Coast Range for grazing cattle; within the analysis area, Little Grass Mountain is known to have been grazed. Some grazing also occurred on scattered BLM lands in the 1940s and 1950s within the analysis area.

COMMODITY FOREST PRODUCTS: Current Conditions

Early Logging

Logging was very successful and profitable in the megawatershed area and also resulted in the development of transportation and fire protection systems. Small communities such as Falls City and Pedee were thriving settlements during the early logging days. They were primarily associated with the active mills and were often self-sufficient, with schools, stores, grange halls, churches and cemeteries. In 1905, a small mill (Mill Creek) was operating near the location of the present BLM park at Mill Creek. A dam 200 feet long and 40 feet high provided the impoundment for the mill. An additional dam and camp (Cedar Creek) was located eight miles south, and loggers working between the two dams would deposit their logs on the bank of Mill Creek. The Cedar Creek dam would be opened periodically to deliver the logs to the Mill Creek mill site. Supplies were brought into Cedar Creek by horse-drawn wagon. This camp was abandoned in 1925.

By 1904, the Salem, Dallas, Falls City and Western Railroad reached to Black Rock and served the Willamette Valley Lumber Co. (later Willamette Industries) and Falls City Lumber Co. mills in Dallas and Falls City. The logging camp at Black Rock flourished between 1905 and 1940 as the logging headquarters for several companies operating in that part of the Coast Range. Black Rock grew into a small town, and logging spur lines were extended in several directions from there. To access the predominately old-growth forest to the west, a main railroad logging spur was constructed west from Black Rock to Old Camp (Riley Peak), with several logging spurs branching off the main ridges. To detect early signs of forest fires, three fire lookouts were constructed in the 1920s and 1940s within the analysis area on Dorn, Condenser and Monmouth Peaks, and have since been removed. The U.S. government first started selling timber in the analysis area in 1923 to the Willamette Valley Lumber Co. Other early logging companies which purchased government timber patents included Spaulding Lumber Co., Engle and Worth, and Pope and Talbot Timber Co. Many of these companies were also early landowners in the area.

Logging in the analysis area focused primarily on the remnant old-growth stands, and by the mid-1980s, the majority of these forests were gone. Large-scale timber harvest and road building continued through the 1980s, though a few mills closed and logs were trucked to mills in the Willamette Valley. By the late '80s and early '90s, the private stands were being harvested a second time, while logging on federal lands slowed to a stand-still due to court injunctions related to environmental concerns. While reforestation was practiced on many of the industrial forest lands, many of the smaller in-holdings were left to seed back naturally following logging; most of these lower valley areas came back to alder or mixed conifer/hardwood stands.

Timber Harvest Potential

The BLM manages 18 percent (25,956 acres) of the 142,169 acres in the analysis area. Based on the number of acres of BLM land that have stands in the early to mid-seral stages in the analysis area (see Table III-3, p. R&CC-18), approximately 78 percent (20,171 acres) of the land has been harvested. Assuming that the average volume per acre at age 100 is 65 MBF, it is estimated that 1.3 BBF of timber have been extracted from the analysis area. On the average, about 336 acres/year were harvested on federal land, yielding approximately 22 MMBF/year.

Below are listed the results of using GIS analysis and several different sets of forest stand criteria to determine the acres potentially available for commercial density management treatments on Late-Successional Reserve and Adaptive Management Area lands in the analysis area:

1. Criteria: 1) age = 20-50 yrs.; 2) > 40% conifer stocking; and 3) outside RRs.
   LSR acres = 3,779
   AMA acres = 318

2. Criteria: 1) age = 51-80 yrs.; 2) > 40% conifer stocking; and 3) outside RRs.
   LSR acres = 255
   AMA acres = 216

3. Criteria: 1) age = 81-110 yrs.; 2) > 40% conifer stocking; and 3) outside RRs.
   AMA acres = 33

4. Criteria: 1) age = 20-50 yrs.; 2) inside RRs.
   LSR acres = 6,316
   AMA acres = 291

5. Criteria: 1) age = 51-80 yrs.; 2) inside RRs.
   LSR acres = 1,249
   AMA acres = 153

To project opportunities for the next decade, an analysis was done to determine the number of acres possibly available for commercial density management within the next 10 years (see Map MP-10):

Criteria: 1) age = 10-20 yrs.; 2) > 40% conifer stocking; and 3) inside and outside RRs.
LSR acres = 1,367
AMA acres = 16

An average stand in the analysis area was modeled using ORGANON (Willamette Valley Version) to determine potential growth, mortality, and timber volumes. Table III-12 (p. R&CC-61) indicates the potential volume in each subwatershed of the analysis area (based on management scenarios 2 & 3 in Appendix VII).

Table III-12. Potential Timber Volumes (per decade) by Subwatershed

Subwatershed	Acres of 21-40 Year Old Plantations	Total Annual BF at 30 yrs.
Rowell	914	147,250
Mill Creek	3,857	621,290
Upper Rickreall	78	12,551
Rickreall	281	45,238
Little Luckiamute	57	9,194
Upper Luckiamute	556	89,534
Clayton/Pedee	724	116,646
Totals	6,467	1,041,703

Table III-13 (p. R&CC-62) summarizes treatment acres (Microstorms data, Salem BLM) for the Marys Peak RA and the analysis area, per decade, and acres treated within the analysis area for these silvicultural projects. The column labeled "RMP Target (acres/decade)" lists the number of acres targeted in the Marys Peak RA for the time period 1996-2005; the column labeled "Target Acres" is the number of acres targeted for treatment within the analysis area; and the column labeled "RMP Target Acres within Analysis Area (%)" is the percentage of target acres within the analysis area with respect to the total Resource Area (see Appendix VII for additional information).

Table III-13. Target Acres in the Analysis Area for Silvicultural Treatments

Silvicultural Treatment	RMP Target (acres/decade for Marys Peak RA)	Target Acres	RMP Target Acres within Analysis Area (%)
Stand Maintenance and Release	5,430[1]	652	12
Young-Stand Density Management	8,450[2]	1,660	20
Early-commercial Thinning	Undetermined	427	Undetermined
Animal Protection	3,230	50	2
Fertilization	1,930	300	16
Pruning	1,200	355	30
Hardwood Conversion	300	133	44

[1] 402 acres treated in 1995-97. [2] 579 acres treated in 1995-97.

Special Forest Products

Special Forest Products (SFP) are limited to vegetative material and include such items as grasses, seeds, roots, bark, berries, mosses, ferns, edible mushrooms, tree seedlings, transplants, conifer boughs, sap, poles and firewood. The top three SFP within the analysis area, based on volume and monetary value, are mushrooms, salal and firewood.

The analysis area has not generally experienced a heavy demand for SFP. The number of permits issued for wood products such as Christmas trees and firewood has been decreasing while the number of permits sold for moss, mushrooms and boughs is increasing. In 1995 about 75 percent of the moss gatherers came from the Salem-Keizer area. However, in recent years the Salem District has experienced an increase in interest and demand for all SFP offered for sale on the district. Table III-14 (p. R&CC-63) is a summary of permits issued in the analysis area from January 1 through December 31, 1996.

Table III-14. Permits for Special Forest Products issued in the Marys Peak RA in 1996.

Product	Permits Issued	Amount	Revenue Generated
Chanterelle mushrooms	8	2,060 pounds	$206.00
Salal	4	1,300 pounds	$140.00
Firewood	20	46 cords	$435.00
Edibles & Medicinals	3	1,958 pounds	$58.65
Moss	1	250 pounds	$11.00
Douglas-fir pitch	3	21 gallons	$108.00
TOTALS	39		$957.65*

* 10 percent of total is a road use and maintenance fee for the removal of SFP.

TRANSPORTATION MANAGEMENT: Current Conditions

The transportation system within this analysis area's forested uplands was originally constructed for management of both BLM-administered and private timberlands, as well as to provide access to a few scattered homesteads. Following WWII, the extensive road system now in place in the uplands developed as a means to access harvestable timber. Extensive road systems beyond settlement and agricultural transportation needs did not appear until the era of industrial logging, when management activities included timber harvest and salvage operations, fire prevention and suppression, and timber stand improvement. These were the only reasons the privately-controlled roads were constructed.

Access roads, which followed major drainages, were constructed to harvest timber using downhill logging methods to about 800 feet upslope from the road location. In the 1950s, uphill logging was initiated to harvest additional timber located further upslope and on ridge tops. Roads were constructed along side-slopes and up to ridge tops to provide access to the timber.

Initially roads were constructed using sidecast construction techniques which involved: 1) removing vegetation and stumps; 2) scattering them down-slope; 3) excavating into the slope; and, 4) placing the excavated material down-slope to produce a flat road template. In many cases, the road fills would cover much of the vegetation, stumps, and logs left from clearing operations. Where roads crossed streams, sound logs were placed and filled over with excavated material, while log stringer bridges were constructed across major streams. Roads were generally 14 feet wide, flat or outsloped, surfaced with native rock material encountered in nearby excavations, and usually followed the contour of the ground. Many roads still exist throughout the megawatershed that were constructed using the sidecast method. As these roads age, the decay of buried logs, stumps and vegetation, and poorly designed road locations result in increased erosion and downstream sedimentation as well as slope failures.

There are no BLM primary roads in the analysis area. (See Appendix VIII for brief definitions of BLM road types.) Because most of the secondary roads were built between 1940 and 1970, impacts on the landscape were greater than would occur using today's construction methods. Over time, some secondary roads have stabilized and present minimal risk to water quality if routinely maintained. Others, however, have culverts or log structures that are deteriorating and in need of replacement. With respect to local roads in the analysis area, the primary problem encountered is runoff which causes scouring of these native surfaced roads. This is due to the lack of maintenance on steeper gradients, especially those used by off-highway vehicles (OHVs).

The eastern (valley) portion of the megawatershed area is accessed by a network of roads administered by Polk County; the western portion (forested uplands) is reached via roads controlled by the BLM and private timber companies. Within those forested uplands, approximately 142 miles of road are controlled by BLM and 186 miles by private timber companies. Of the BLM administered roads, approximately 120 miles (85 percent) are surfaced with crushed aggregate, 5 miles (3 percent) are bituminous, and 17 miles (12 percent) are natural (dirt) surface. Table III-15, "Road Status" (p. R&CC-65), provides additional information.

Management activities including timber harvest and salvage operations, fire prevention and suppression, and timber stand improvement are the primary reasons roads continue to be maintained today. Although the BLM roads were constructed for these same reasons, public use is now an additional factor in determining what level of maintenance to apply to each road segment. Road maintenance projects proposed for the next several years are summarized in Appendix IX, "Road Project Recommendations" (p. A-37).

Another factor influencing the standard at which BLM roads will be maintained is that the majority of BLM lands within the analysis area are designated as LSR. For that reason, BLM will carefully manage the network of BLM-controlled roads. However, because private landholders need to retain access to their lands, the need remains to maintain and occasionally upgrade roads passing through federal lands.

The recently completed inventory of analysis area roads revealed some additional items/issues worthy of consideration which are summarized as follows:

- Drainage Structures: Because of the advanced age of many structures, replacements are needed. There are a number of culverts which have rust-deteriorated bottoms or other damage that requires attention. Many other culverts are inadequate to handle 100-year flood events. Also, the few original log structures remaining from early road construction are in various stages of collapse; some on long abandoned spurs have breached the fill and stabilized, while others need attention before the same occurs.

- Road Surface: Because the Dallas and Falls City watersheds are within this analysis area, the

Table III-15. Road Status

ROAD STATUS	SURFACING			TOTAL MILES	TOTAL MILES%	ROAD DENSITY
	BLACK- TOP	ROCK	NAT.			
Total in Analysis Area	**5**	**876**	**33**	**914**	**100.0**	**4.1**
BLM-controlled on BLM	**5**	**111.8**	**16.2**	**133.0**	**14.6**	**3.1**
BLM-controlled on Private	**0**	**8.6**	**0.8**	**9.4**	**1.0**	**N/A**
Non-inventoried Privately-controlled on Private *	**0**	**N/A**	**N/A**	**749.7**	**82.0**	**4.2**
Privately-controlled on BLM	**0**	**20.5**	**1.4**	**21.9**	**2.4**	**N/A**
BLM Roads Closed**	**0**	**N/A**	**N/A**	**19.8**	**2.2**	**0.5**

* = Unknown Status or Surface Type; ** = Ditches, Earthberms, Vegetation, Logs/Debris

consequences of road sediment are critical. The BLM controls only 16 percent of the total roads in the analysis area (see Map 9, p. R&CC-66), so its capability to manage the sediment issue is extremely limited. One direct source of sediment comes from non-surfaced roads crossing intermittent or perennial streams. Aggregate surfacing and maintenance are the two most important ingredients in minimizing surface erosion.

! Road Closures: Historically, roads controlled by the BLM have remained open for public use, except for occasional periods of extreme fire danger. Except in the few cases where the BLM has acquired exclusive easements across private lands, public access across private lands is not guaranteed. Therefore, any road (or road segment) under private control can be closed to the public whenever the private party determines closure is necessary. If, however, the road is encumbered by a reciprocal agreement or non-exclusive easement, administrative use is assured to all participating parties. Public use access to BLM lands can only be guaranteed on those roads which BLM controls entirely until connecting to a county or state road.

Because of the proximity of the uplands to valley communities, a significant number of visitors utilize the transportation system to participate in dispersed recreational activities

Map 9, Road Control, goes here

including motorcycle riding, hunting, shooting, camping, sightseeing, firewood cutting, mushroom picking, etc. These activities are appropriate; however, when illegal dumping and property damage occur, limiting access may be implemented. Gate installations and other road closures have been instituted by various landholders, particularly in proximity to the Dallas and Falls City watersheds, to reduce such abuses.

- Road Maintenance: The maintenance responsibility for all roads lie with the controlling party. BLM secondary roads are generally well maintained during periods of commercial use, but otherwise receive infrequent attention. These roads are maintained to provide management access to both BLM and private lands.

- Quarries: A few quarries are within the analysis area boundary; two large quarries are found on Mill and Rickreall creeks. Due to the limited quantities of hard rock in this area, these are important sources. The material quarried from these sites can benefit sediment control following road construction, as well as provide a source of large, coarse fragments for fish habitat restoration work.

RECREATION: Current Conditions

Euro-American recreational activities probably began in the 1880s when homesteaders moved into the area. As the few primitive roads and trails were built into the forest lands, these new residents undoubtedly began to hunt and fish, and may have spent some of their limited leisure time exploring the backcountry. With the small population and limited access, use of the forested uplands was probably not very extensive until well after the turn of the century.

The major factor contributing to higher levels of recreational use was the improvement of State Highways 22, 231, and 20, along with the more primitive secondary roads. Recreation pursuits remained the same as in homesteading days, but more people in the region were able to participate. The biggest changes over time were providing access to the interior forest by road construction and the increase of motorcycle trail riding in the 1970s within the Rickreall Creek drainage.

Dispersed recreation is common in the analysis area. The greatest number of users are anglers, hunters and backcountry drivers. Berry picking, sightseeing, and camping occur on a more limited basis. Visitor use is highest during the summer and fall, and demand for primitive camping areas, hiking trails and back-country roads will continue.

To date, the BLM has not placed an emphasis upon developing a recreational plan for the analysis area, but has instead allowed the public to establish its own uses. Considering the topography and geographical features of the area, development would likely be limited to maintaining or enhancing the existing uses described below. Local residents have indicated important elements for recreation opportunities are the absence of people, or of obvious traces of them, i.e., remoteness and solitude. Hiking trails, primitive camping areas and back-country roads will experience greater use as demand for these resources increases. High demand and use lead to crowding and user conflicts which threaten the remoteness and solitude desired by many. Types of recreational use can be summarized as follows:

- Day Use: The BLM manages Mill Creek Park, a day-use facility located approximately two miles south of Buell, on Mill Creek Road. The park consists of approximately 12 picnic sites, with pit toilets and a hand-cranked well. Public use of this facility is light, with the majority of use occurring during the summer.

! Fishing: Recreational fishing use in this analysis area is moderate. Native cutthroat and stocked rainbow trout provide fishing opportunities to nearby communities. A small run of native winter steelhead also provides angling opportunities; however, restrictive regulations and the absence of stocked hatchery fish limit angler interest in this resource. The majority of recreational fishing occurring on BLM land is on Mill Creek during the spring and summer. (Steve Mamoyac, Fisheries Biologist, ODFW, pers. comm.)

! Hunting: The following is a summary of the big game presence, recreational use of big game and possible impacts on big game from other recreational uses within the analysis area. (The source of this information is Doug Cottam, District Wildlife Biologist, ODFW.) The information itself was obtained through aerial and spotlight surveys of deer and elk, contacts with local game officers and hunters, and personal observations by current and past ODFW staff.

The analysis area has a relatively high density of black-tailed deer which are hunted fairly intensively by residents of the local communities. Where access is available, the area provides high quality deer hunting given the current availability of habitat types. Roosevelt elk numbers are low, but increasing; local landowners hunt these elk intensively without much success. The farther west into the coastal mountains, the higher the density of elk. Deer and elk adapt well to human disturbance, and it is unlikely that the area's current recreational activities adversely affect their numbers or movements. Bear and cougar exist within the analysis area, but very little hunting occurs for these species. Cougar numbers are increasing along the Middle and Upper Luckiamute Rivers.

! Mountain Biking: There are recently constructed mountain bike trails located on Boise Cascade Corporation land in the Rickreall Creek drainage of the analysis area.

! Motorcycle Use: The Rickreall Creek drainage was closed to unauthorized motorized vehicle use following the Rockhouse Creek fire in 1987. The remainder of the analysis area is open to motorcycles, with sporadic use mainly occurring on secondary gravel and dirt roads.

! Pleasure Driving: Though unmonitored, visitors frequently engage in pleasure driving through forested areas. The upkeep of roads and signs, as well as the availability of transportation maps, accommodates these users.

! Special Forest Products: Picking one pound or less of mushrooms for personal use is presently allowed without a permit. A relatively high number of recreational users probably take advantage of this opportunity.

CHAPTER IV: SYNTHESIS/ INTERPRETATION, & MANAGEMENT RECOMMENDATIONS

INTRODUCTION

The purposes of Synthesis/Interpretation are to: compare existing and reference watershed conditions in light of the core ecosystem elements, issues and key questions described in the first three chapters; explain how and why things changed (or did not change); describe trends; and identify the ability of the analysis area to meet NFP and RMP objectives.

The purpose of the Management Recommendations developed by the watershed analysis team is to identify activities that will mitigate specific watershed issues in order to meet NFP and RMP objectives.

In the following section, recommendations made by individual resource specialists (see the first page of this document for the names of the team members) are given. Since they were developed based on the specialists' view of what was best for their particular resource — soils, water quality, wildlife, etc. — a number of conflicts arose between resource specific recommendations. Every effort was made to minimize such conflicts. See Management Recommendations at the end of this chapter for a list of synthesized (conflict free) recommendations.

LAND TENURE: Synthesis & Interpretation

Land ownership, and the patterns it creates on the landscape, can be considered a disturbance regime similar to fire or windthrow. Currently, the forests in the analysis area are fragmented by four major, five 'minor,' and numerous smaller landowners (See Map 3, p. C-4). The majority of land, 80 percent (113,437 ac.), is owned by private timber companies and managed for timber production. Forests under private ownership are typically harvested during the mid-seral stage (40-79 years) of forest successional development. Oregon Department of Forestry State regulations provide protection to forest soil and water resources, and require reforestation, but landowners manage their lands in differing ways, thus creating a patchwork of diverse aged stands usually cut along straight-lined property boundaries.

Under the Northwest Forest Plan, all federal lands in the analysis area are designated as Late-Successional Reserve and/or Adaptive Management Area. These allocations are designed to provide suitable habitat for late-seral and old-growth dependent species by managing ecosystems to protect, maintain or enhance late-seral and old-growth forests and their characteristics. In the end, these different management regimes — private and public — preclude the existence of a landscape matrix, increase the amount of edge, and decrease the amount of interior forest habitat available in the analysis area. [Note: In this instance, "landscape matrix" means the predominate forest seral stage which would exist in the absence of disturbances (fire, windthrow, etc.); in the analysis area, this matrix would be LSOG Douglas-fir. The term "Matrix" is also used in the NFP to refer to a particular LUA.]

The Northwest Forest Plan states that land exchanges involving LSR can be considered if they provide benefits to current conditions and should be considered especially when LSR occurs in a checkerboard pattern with private ownership. The *Late-Successional Assessment for Oregon's Northern Coast Range Adaptive Management Area* recommends blocking-up federal lands to improve connectivity and increase the expansion of interior forest habitat. The *Salem District ROD/RMP* also recommends land tenure adjustments where they would benefit a variety of uses and values.

There are differing opinions among team members over how to manage scattered and isolated tracts of public forest lands. Some believe that the Bureau should exchange scattered and isolated BLM parcels for private lands surrounded by BLM lands in order to create larger blocks of habitat. Others, however, are not in favor of blocking-up BLM lands because they believe these scattered and isolated tracts of existing (or potential) LSOG serve as important islands of refugia for many plants and animals that are surrounded by a continuous sea of early and mid-seral forests.

LAND TENURE: Management Recommendations

! Create a Salem District Land Tenure IDT to determine, at a Coast/Cascade Range province level, the best give-and-take exchange strategy for the 9,900 acres of Land Tenure Zone 3 lands in the District (*Salem District ROD/RMP*, USDI, BLM 1995). The analysis area considered here is completely within Land Tenure Zone 2, except for 215 acres of Zone 3 lands. Lands within Zone 3 may be blocked up in exchange for other lands in Zones I or 2, transferred to other public agencies or given some form of cooperative management. The watershed analysis team was unable to agree upon a land tenure adjustment strategy at the watershed level, but a majority of the team members felt that some acquisition of lands in the Mill Creek watershed would improve the Bureau's ability to conduct ecosystem management.

SOILS: Synthesis & Interpretation

Soil displacement processes that occurred under reference conditions due to windthrow, soil creep, landslides, and surface erosion still occur today. In addition to these "natural causes," modern activities associated with logging, site preparation, and road building also result in displacement of soil. Recent efforts to minimize activities that disturb top soil have greatly diminished forest soil displacement. Many of the Recommendations listed below will serve to reduce the amount and extent of soil displacement further.

Compaction and related loss of soil productivity have increased in the post-settlement period in contrast to reference conditions. This has been largely due to the effects of logging practices (tractor yarding in the 1940s-1960s, primarily) and to a lesser extent, road building. The current practices of one-end and full suspension yarding and mitigation of compaction by ripping have lessened the amount of soil compaction occurring in recent times. The Northwest Forest Plan, with its reduced logging levels, will also lessen the amount of new compaction occurring. Existing compaction varies in depth and extent. Studies indicate that compacted soil slowly returns to an uncompacted state over many decades, so the negative effects from compaction can be expected to last well into the next timber rotation.

The surface erosion and landsliding seen today are the effects of the same processes that occurred under reference conditions. However, the causes for landsliding characteristics in the analysis area (e.g., intensity and rate of landsliding) likely vary substantially between the two periods. Although data on intensity and timing of erosion and landsliding prior to 1900 are unavailable, we can infer from current observations and data that the rate of surface erosion and landsliding is greater today than under reference conditions. Road construction and logging are the major factors for this increase. Trends may improve with adoption of the Northwest Forest Plan. Re-establishment of vegetative cover in high risk erosion areas and continued road maintenance are necessary to reduce the possibilities of road-related surface erosion and landslides in the future. (See maps MP-1, "Slope Hazard," and MP-2, "Landslides & Slide Tracks," for location of steep slopes, landslide origins and tracts.)

Moderate to severe potential surface erosion and/or landslide areas (slopes above 60%) occur on 8,380 acres in the analysis area (1,476 acres are on BLM). The number of existing landslides that occurred between approximately 1950 and 1996, identified by inspection of 1956-1996 aerial photographs, is 288; 58 were on BLM and 230 on private. Additional landslides likely occurred under the timber canopy but were not identified due to the limits of the aerial photo survey.

Much of the analysis area contains timber of commercial size, and harvest activities are expected to increase. This will result in construction and hauling activities on new and existing roads. This disturbance, as well as yarding activity, is predicted to increase the erosion potential in the analysis area. When in close proximity to streams, these disturbances may result in increased sediment entering the streams for a period up to five years.

SOILS: Management Recommendations

For all lands, regardless of slope class:

! Limit season-of-use for ground based equipment to periods when soils are driest; also avoid wet season non-suspension cable yarding.

! When tractor yarding, use designated skid roads spaced at least 100-150 feet apart.

! When yarding with a harvester-forwarder or tracked hydraulic shovel, require equipment to run on top of slash to distribute weight bearing over a larger surface area. Additional slash may need to be placed on yarding roads to maintain adequate weight distribution and protect soils. Design the project to keep the number of equipment passes to a minimum.

! Only rip (usually reserved for regeneration harvests) where soils are compacted and there is little or no vegetative cover.

For lands with greater than 75 percent slope gradients:

! Minimize new road construction across these slopes.

! Study all roads within landslide potential areas and consider the following:

  C Decommission roads not required for other uses or needed for access to other lands.

  C Roads that are needed for land management activities should be upgraded to reduce the potential for slope failure.

- Construct deep dips or out-slope road surfaces over existing culverts to reduce potential culvert fill failures. Armor the fill slope to allow water to flow over the road with minimal erosion damage to the fill.

- Renegotiate existing road access agreements on roads crossing through unstable slopes, with the goal of improving, relocating or closing high risk roads.

- Develop and implement a road maintenance program to protect roads and minimize road impacts to other resources.

- On slopes greater than 75 percent in Rickreall, Mill and Rowell Creek drainages, keep vegetation disturbance to a minimum, or preferably, avoid disturbance entirely. On slopes between 75 and 90 percent elsewhere in the analysis area, maintain a high amount of viable root structure in the ground following management actions.

- When logging operations occur, consider the following:

  - Try to maintain total suspension logging over convex slopes and at least one-end suspension elsewhere.

  - Restrict yarding to the dry season.

  - Protect all vegetation in headwall areas.

  - For site preparation, use only light impact, "spring-like" burns or no burning. Maintain a majority of the duff layer and a large component of debris on site to stabilize the surface. To avoid excessive loss of duff, only burn when duff moisture levels are high, then mop up units quickly after burning.

For lands with slope gradients of 60 to 75 percent:

- When logging operations occur, consider the following:

  - Recommend total suspension logging over convex slopes, and one-end suspension yarding on as much area as practical. Where suspension is limited over convex slopes, restrict yarding to the dry season only.

  - For site preparation, use light to moderate intensity, "spring-like" burns with rapid mop up or alternative low impact treatments. Maintain the majority of the duff layer and a moderate amount of debris on the ground to stabilize the soil surface.

  - Minimize compaction of the soil.

For lands with less than 60 percent slopes:

- Avoid unstable areas for roads and landing locations.

HYDROLOGY, STREAM CHANNELS, & WATER QUALITY: Synthesis & Interpretation

Once again, it is important to recognize that with the exception of Upper Mill Creek, public lands are a small proportion of the analysis area; therefore, hydrologic, stream channel, and water quality conditions will be driven primarily by management of private landowners. Even if all of the aquatic ecosystems on public lands in these watersheds were to function near to optimum reference levels, these effects would be overwhelmed if the cumulative conditions on private lands are less than optimal. Disturbance of hill-slopes in the analysis area will probably create a high potential for negative impacts to hydrologic function, stream channels, and water quality as a result of the cumulative effects of the following: high precipitation and runoff rates; the concentration of TSZ in the subwatersheds; the precipitous nature of the local geology (dissected volcanic uplands in the north); high road densities; and the frequency of disturbances from forest management in this century.

Since public lands throughout this area are now likely to be left undisturbed or at most receive some density management, the general trend is for recovery of hydrologic conditions to near reference levels on most surfaces managed by the BLM. However, in some cases, full recovery will be unattainable because the landscape has been altered so extensively (e.g., road construction). The analysis presented in this document noted a concern here, but more information is needed to properly assess the degree of impact from roads to hydrologic processes in the analysis area and the trends for these processes. In general, these effects are likely to be most prominent in Mill Creek where the BLM manages a high proportion of sensitive hill-slopes.

Trends for hydrologic processes on private lands are not as clear since management decisions on these lands are largely market driven. However, with the high proportion of conifer stands at harvestable age, and the trend on private lands toward short rotations (40-50 years), as much as 50 percent of the analysis area is likely to be harvested in the next ten years. Therefore, the trend on private lands, and hence in the analysis area overall, is for a continuation of the high levels of hill-slope disturbance, with a proportionally high rate of surface and watershed response to this disturbance. Hydrologic and geomorphic processes (e.g., sediment production and delivery to streams, peak flow response, alterations in surface capture and routing of water, etc.) are likely to remain at the high end of the range assumed under reference conditions. To a large extent, the magnitude of this disturbance will hinge on how private land managers treat sensitive hill-slopes (i.e., hill-slopes with gradients over 70%), manage surfaces in sensitive areas (such as snow and TSZ zones), and manage the extensive and sporadically maintained road system. In particular, this will affect aquatic ecosystems in watersheds with a high proportion of sensitive hill-slopes, such as Mill Creek and Rickreall Creek.

Stream channel response to the continuation of high disturbance rates in the analysis area is fairly easy to predict. Sediment delivery to streams from sources in forested uplands in this analysis area depends primarily upon disturbances (e.g., forest management, storm events) on high gradient hill-slopes. Field investigations to date indicate that source and transport channels have higher sediment loads (particularly large material moved as bed load in channels) and reduced roughness, particularly CWD, relative to reference condition. This is particularly true of streams adjacent to steep uplands.

On private lands, disturbance of hill-slopes will continue to set the stage for landsliding. Bed load supply is therefore likely to remain higher than reference overall. In watersheds that are "sensitive" to disturbance, such as Mill Creek and Upper Rickreall, this may result in high rates of landsliding, with continued disruption of riparian zones and channels. Depending on how private forest owners choose to manage these areas, channel recovery may be slowed or even reversed in the next decade as mid-seral stage (40-80 yrs old) stands, which cover as much as 50 percent of the analysis area, are harvested.

On public lands, where the assumption under the Northwest Forest Plan is for minimal disturbance from logging activities and road construction, the long-term trend (next 100 years) is for slow recovery to near reference conditions as hill-slope failures decrease, riparian areas recover, in-channel CWD increases, and channels rework and/or transport bed load out of the system. However, these channels do not exist in isolation and trends will be altered in response to conditions on tributary channels, many of which are privately owned. In addition, full recovery of hydrologic conditions — even on public lands — will be hampered by the impacts of road surfaces. This may be reflected in the condition of stream channels that intersect this road system and recovery to reference condition on these channels will be proportionately reduced.

The trend for many low gradient response and depositional channels in the analysis area, where the degradation is so advanced that full recovery to reference conditions is highly unlikely, is for continued poor functioning with poor water quality for the foreseeable future. This is likely the case in lower Mill Creek and some of its tributaries, such as Gooseneck Creek, where historical disturbance likely induced a dramatic change in channel conditions and continuous impacts from the upper watershed (i.e., large volumes of water and bedload sediment) prevent channel recovery (Hawe 1997). In a few instances, recovery to a level that is adequate to support the range, if not the quantity and quality, of aquatic habitat under reference conditions is possible given time and/or direct human intervention. The BLM manages very little of this stream type and hence has only an indirect influence over its condition.

Fine sediment supplies are likely to remain higher than reference on both private and public lands, due to surface and stream bank erosion from agricultural areas and road surfaces in forested areas. Without a huge investment in materials and energy directed at reducing the contributions from these source areas (all directly related to human activity), this trend is unlikely to alter substantially for many years and could be considered, in effect, a new “reference” level for fine sediment.

Stream temperatures are likely returning to reference conditions as awareness and concern for protection of riparian vegetation has become standardized. The trend here is for recovery to near reference conditions. However, where channel and floodplain degradation has altered base flow and increased exposure of surface water to solar radiation, the trend is for continued high stream temperatures during the summer. A case in point is lower Mill Creek, where temperatures are likely to remain above standard for many years due to poor channel and floodplain condition.

HYDROLOGY, STREAM CHANNELS, & WATER QUALITY: Recommendations

! Minimize constructing additional stream crossings. Evaluate any proposed new or renovated stream crossings using the criteria developed in the Benton Foothills WA (See Appendix X).

! During the Timber Management Objectives process, evaluate roads for risk(s) of contributing to cumulative effects to the aquatic ecosystem. Factors to consider include proximity to the riparian zone, hill-slope stability, TSZ, road maintenance and use, and age and construction methods. In general, Mill Creek and Upper Rickreall Creek have the greatest concentration of high risk roads. Road segments should be considered candidates for upgrading and/or decommissioning on a prioritized basis, with risk for cumulative effects as a primary consideration factor.

- Stream crossings on high gradient, unstable stream channels (i.e., "source" streams) should be evaluated for their potential to interrupt the passage of debris torrents and/or to divert stream flow. Upgrade crossings, on a prioritized basis, to allow for passage of debris torrent material without blocking and/or diversion of streamflow.

- Renovate old roads and construct any new roads to limit the interception and routing of surface and groundwater directly to stream channels. Instead, route water captured on road surfaces to stable hill-slopes. This can be accomplished with a combination of out-sloping, rolling dips, more frequent ditch relief culverts, etc. A higher priority should be placed on roads in the TSZ, in Riparian Reserve areas, and/or on high gradient hill-slopes.

- Avoid disturbing hill-slopes with gradients >80 percent.

- Apply the criteria developed in the Benton Foothills WA (See Appendix X) for evaluating any projects for stand manipulation (thinning, conversion of hardwood stands, etc.) in Riparian Reserve areas.

- Evaluate the potential for placing debris dams and/or "key" logs at natural catch points in transport and response channels (i.e., at tributary junctions, constrictions, outside bends of meanders, etc.).

- Continue to investigate stream temperature conditions on Upper Mill Creek. Focus on applying stream temperature models to refine our understanding of reference conditions and to identify factors which can be manipulated through forest management.

- Sample for E-coli contamination of Mill Creek at heavily used recreation sites in the upper watershed. Coordinate with adjacent private landowners to improve management of recreational uses of the Mill Creek watershed (i.e., swimming, hiking, off-road vehicles, etc.).

- Evaluate the potential for habitat and channel rehabilitation in depositional flats and channel segments with gradients less than one percent.

- Place a high priority on blocking-up BLM ownership in the Mill Creek watershed.

- Any future iterations should evaluate the Rickreall-Mill Creek watersheds independently from the Luckiamute River system.

VEGETATION

FIRE & FOREST UPLANDS: Synthesis & Interpretation

This analysis area has changed from a fairly homogenous mid- to late-seral forest prior to Euro-American settlement to an area consisting of many small, early seral stands interspersed with remnant patches of the original forest.

Historically, the analysis area was shaped through the large scale disturbances of fire, wind, insects and disease. These factors were significant in affecting the age class and species distribution of vegetation in the Coast Range. Post-Euro-American settlement introduced new disturbances which were significant in shaping the analysis area as it is known today. These disturbances are logging, road building, fire suppression, salvaging diseased and/or windthrown timber, and additional landslides created from these practices. All of these disturbances have significantly reduced the vegetative structural diversity as well as the amount of snags and coarse woody debris that are thought to have been present at the turn of this century.

Currently, due primarily to logging, 93.6 percent of the analysis area is in early and mid-seral stages, less than 80 years of age (See Map MP-3, "Conifer Forest Seral Stages/Habitat Types"). Most of these stands tend to be densely stocked with relatively few snags. A few large, green "wolf" trees or scattered old-growth occur within some of these stands. However, most stands lack structural and density diversity. Lack of wildlife tree retention in older logged units as well as slash burning and timber salvage have reduced the amount of coarse woody debris found within individual stands of timber. Large dead and down material is generally available in these stands as legacies of previous stands, although most is in decay classes four and five.

Estimates of the amount of the Coast Range that was occupied by late-seral conditions prior to Euro-American settlement range from about 40 to 80 percent (Teensma et al. 1991; Franklin and Dyrness 1973; Agee 1993; Ripple 1994). Current data indicate that approximately 6.4 percent of the analysis area is included in late- and old-growth seral stages, all of which occur on BLM-administered land.

With the adoption of the Northwest Forest Plan, the majority of BLM lands within the analysis area fell within the North Coast LSR. Current trends show improving conditions for the composition of older forest stands as well as structural diversity on BLM and USFS lands. The current trends for private lands, the majority of the analysis area (approximately 80%), are largely dependent upon the Oregon Department of Forestry Rules (Oregon Forest Practices Act). The majority of non-federal lands in the analysis area are used for the production of timber on short rotations of around 50 years. Since most of these lands have already been harvested in the last 20-30 years, the current trend on private land would be an increase in mid-seral forest acres until they again reach an age of final harvest in two to five decades.

Red alder is a pioneer species following large scale disturbances. Historically, red alder was common along riparian and alluvial flats and in areas that were periodically disturbed, exposing bare soil (landslides, slumps, etc.). Red alder cannot survive long drying periods during germination, hence it is restricted to moist, scarified (exposed soil) sites in much of its range. Wet bottoms and steep slopes with active seepage favor red alder over Douglas-fir (Trappe et al. 1967). Although still abundant along streams, today many of the hardwood stands within the analysis area occur adjacent to roadways or as scattered trees or patches of trees in unmanaged conifer stands.

FIRE & FOREST UPLANDS: Management Recommendations

- Retain all federal lands within individual drainages to larger watersheds in order to provide for older forest species diversity within the analysis area. These scattered parcels of federal land are important in the distribution of old-growth species and species diversity. These "federal refugia" may also provide protection to known (and unknown) plant and fungus sites and prevent some species associated with older forests from becoming listed as threatened or endangered.

- Inventories are key to management, and the following are inventory needs:

  - Conduct stand exams to determine whether snag and/or down woody management is needed within

the analysis area.
- Create estimates in the analysis area on late-seral and old-growth forest trajectories.
- Determine accurate seral age classes of existing vegetation on private lands in the analysis area to create an accurate map of seral age classes.
- Survey special plant habitats and ACECs to determine the presence of special status and special attention species.

! In project areas less than 110 years of age, manage tree density to increase growth and achieve structural and density diversity.

! Release conifers that occur in hardwood stands adjacent to roadways. Identify unmanaged conifer stands currently dominated by hardwoods for stand conversion projects. In areas with dense hardwoods, conduct conifer release treatments.

! Consider preparing a prescribed fire plan for underburning in stands to increase structural diversity.

! Consider preparing a prescribed fire plan for burning existing or new openings in stands and on ridge-tops to maintain or create structural diversity and favor open grassland species.

! Continue fire protection and suppression of wildfires due to the high value of the resource and the scattered nature of land ownerships.

RIPARIAN RESERVES: Synthesis & Interpretation

Thirteen percent of the Riparian Reserve and OFPA buffer acres in the analysis area consist of hardwoods (1,690 acres of BLM land). Many of these areas are narrow strips along streams and pose no barrier to CWD recruitment, stream shading or development of older forest characteristics since alders will eventually be shaded out as conifers on slopes above increase in height. Other hardwood areas occur on relatively broad floodplains with high water tables where conifer stands do not naturally develop. Neither of these types of areas need restoration/enhancement. There are other areas, previously occupied by conifers, where hardwoods have seeded in after a logging operation and have to come to dominate the site. These areas may be suitable sites for restoration activities (see "Recommendations").

The proportion of hardwoods will likely remain the same or decrease in the analysis area as a whole as private industry converts streamside hardwoods to conifers. Hardwoods on BLM land will likely decrease under the Northwest Forest Plan as disturbance from logging and road building in Riparian Reserves decreases.

With the implementation of the 1997 revised OFPA, stream-side riparian protection buffers are now required on private and State-owned lands. Protection widths vary depending upon stream type and size. The new rules restrict cutting in some riparian areas, allowing trees growing within 20 feet of streams to remain uncut. However, because mandated buffer widths are much less than those required on federal lands, wide corridors with older forest characteristics will not develop on private lands. About 90 percent of the BLM Riparian Reserves consist of conifer stands which will eventually develop older forest characteristics under the Northwest Forest Plan. However, federal ownership within the analysis area is limited to a small percentage of the total acres, and total late-seral riparian habitat is expected to remain low.

As Riparian Reserves and Late-Seral Reserves on federal land begin to develop older forest characteristics, a contiguous block will develop along the west boundary of the analysis area, connecting with the Upper Siletz watershed.

Federal land within 15 meters of streams is currently within the range of reference conditions for stream-side vegetation shade and will remain so because no further regeneration harvesting will be done within 15 meters of streams. In addition, with new OFPA regulations, which generally prohibit removing vegetation within 20 feet of a fish-bearing stream, the trend on private lands is toward retaining stream-side vegetation and lowering the risk of higher stream temperatures.

The trend for BLM lands is toward increased CWD potential because the goals for Riparian Reserves and LSRs include increasing CWD. However, because private lands are managed under a different set of riparian regulations, they will have a lower percentage of lands with a high CWD potential. For the analysis area as a whole, combining federal and private lands, riparian areas with high CWD potential could approach 50 percent if federal lands continue to be managed for CWD recruitment because federal Riparian Reserves are significantly wider than those mandated by the OFPA.

RIPARIAN RESERVES: Management Recommendations

! Management activities in the Riparian Reserves should be used to promote older forest characteristics, attain ACS objectives and move the Riparian Reserves on a trajectory toward older forest characteristics (see Appendix V, "Riparian Reserve Project Design"). Desired riparian characteristics include:

- C Diverse vegetation appropriate to the water table, geomorphic land type and stream channel type
- C Diverse age classes (multi-layered canopy)
- C Mature conifers where they have occurred in the past
- C Dead standing/down wood
- C Stream connected to its floodplain (floodplain inundated every 1-3 years)
- C Stream bank vegetation with adequate root strength to maintain bank stability

! As stated in the *Late-Successional Reserve Assessment for Oregon's Northern Coast Range Adaptive Management Area* (*LSRA*, p. 91), because many objectives for LSRs are similar to Riparian Reserves objectives, activities appropriate for management in LSRs are also appropriate for Riparian Reserves as long as these activities are consistent with ACS objectives. Therefore, instead of developing separate guidelines for managing within Riparian Reserves in the analysis area, it is appropriate to use management guidelines developed in the *LSRA*. Site-specific analysis will still be required to ascertain whether the proposed project is consistent with Aquatic Conservation Strategy (ACS) objectives (see Appendix V, "Riparian Reserve Project Design"). Management priorities should include:

- C Areas designated as high priority by wildlife biologists for marbled murrelet habitat.
- C Areas designated as high priority by the *LSRA*.
- C Areas of connectivity to adjacent watersheds.
- C Riparian areas where in-channel improvement is planned or has been completed.
- C Areas adjacent to private lands.

Other management activities in the Riparian Reserves include:

- C Fire: prescribed fire can be used at any age to achieve management objectives within the guidelines

of the *ROD/RMP* and the *LSRA*.
- Special Forest Products: the guidelines set out in the Resource Area EA covering these products will be followed in the Riparian Reserves.
- CWD: using the *LSRA* and recommendations of biologists, design management activities in the Riparian Reserves which will provide for down wood and snags in all decay classes over the life of the stand.

! Following the guidelines in the *LSRA* and Appendix V, "Riparian Reserve Project Design," the following reaches, as well as others identified after this analysis, should be examined for restoration/enhancement opportunities:

- T. 9 S., R. 7 W., Sec. 13, 020: release conifers
- T. 9 S., R. 7 W., Sec. 11, 170: plant western redcedar along the slide on the east edge of this unit.
- T. 7 S., R. 7 W., Secs. 4 and 3: release conifers
- T. 7 S., R. 7 W., Sec. 13: release conifers

! Inventory stands between ages 20 and 110 to determine if they are developing older forest characteristics and if they would benefit from creation of CWD, density management or some other treatment to maintain or restore ACS objectives.

! Inventory stands over age 110, looking at stands along lower gradient streams first. (There have been no data collected from stands over age 110 in the Riparian Reserves. Some may be developing older forest characteristics and may be able to serve as reference riparian stands.)

SPECIES & HABITATS

PLANTS: Synthesis & Interpretation

Few special attention species have been reported for this analysis area. The primary reason for this is that while other watersheds have had surveys done associated with timber driven projects, this analysis area has had few projects proposed. As projects are implemented and surveyed, new sites will be located for both special status and special attention species.

Special plant communities such as dry and wet meadows, wetlands, and cliff and talus habitats remain relatively unmapped for the analysis area. The majority of these "special areas" are mapped on BLM lands but remain unmapped for private lands in the analysis.

Four ACECs are located in the megawatershed (see Chapter 3, "Plant Habitat," p. R&CC-37), special botanical areas). Other than threats from activities or processes on adjacent private lands (such as clearcuts, thinnings and/or road construction which can lead to windthrow and/or a slight increase in noxious weeds on adjacent land), there are no current activities or processes that threaten the integrity of the ACECs within the megawatershed area. However, future activities on BLM lands adjacent to the Forest Peak ACEC could threaten its integrity (see recommendation below).

Several species of noxious weeds are known to occur within the analysis area (see Chapter 3, "Plant Species," p. R&CC-41). Most of these species are common and widespread, while a few "new invaders" are known from only a few sites in the Megawatershed. All known noxious weed species that occur on

BLM lands in the analysis area are believed to be widespread throughout the analysis area. These species tend to persist on adjacent roadways and in disturbed areas. They tend to become established immediately following timber management activities but are out-competed by native vegetation over the next five to ten years. Control or containment of these species is mostly through biological control, and complete control of these species is not expected.

Scotch broom (*Cytisus scoparius*) poses the greatest threat of vegetative competition in the analysis area. Although it is a minor threat at this time, this species is known to "seed bank" for many years so that following timber harvest and/or road construction years from now, competition from this species on young plantations may create severe silvicultural problems.

PLANTS: Management Recommendations

- Initiate surveys for special status and special attention plant, fungus, and bryophyte species, record and store locations in a database, and eventually develop a GIS layer.

- Inventory the number, location and size of special plant communities in the analysis area, record and store the locations in a database, and eventually develop a GIS layer reflecting these locations.

- Initiate the IDT process to determine the importance and relevance of **expanding the boundary of Forest Peak ACEC** (currently 134 acres) to include the entire BLM parcel it is located in. This additional 26 acres would increase the size of this ACEC to 160 acres and provide additional protection to the critical elements of this ACEC. It is recommended further that no non-emergency management actions be taken in these 26 acres until the IDT process has been completed.

- Monitor each ACEC periodically to determine if any current activities or processes threaten their integrity.

- Use native plant species whenever they are available for the revegetation of disturbed areas. If these species are not available or cost-effective, use revegetation methods that do not encourage the introduction or spread of noxious weed or other invasive non-native plant species.

- Continue inventories for noxious weed species throughout the analysis area to determine the extent of infestations.

- Eradicate new populations of Scotch broom to help prevent future problems from "seed banking."

FISH: Synthesis and Interpretation

Significant events in the past 150 to 200 years have impacted the analysis area and consequently changed fisheries habitat. Historic natural conditions were established from fire, floods, landslides and windstorms. Current conditions have been established by human activities such as timber harvest, splash dams, and road construction, in addition to natural events that continue to occur (fire, floods, landslides and windstorms). It is evident that fish habitat has become more impacted from current activities than from historic natural activities. Among the most significant of these impacts are the lack of coarse woody debris in streams, increased soil movement, decreased fish migration, and loss of large conifer trees in riparian zones. These impacts are caused partially by timber harvest activities and road construction.

It is important to note that approximately 97 percent of the anadromous fish habitat in this analysis area is managed by private landowners; since this analysis concentrates on BLM-managed lands, improvement opportunities will be limited. There are only 57.9 stream miles of resident fish habitat and 1.7 stream miles of anadromous fish habitat on public lands in the analysis area (see Table III-11, p. R&CC-50). Due to the pattern of public land distribution, fisheries management is limited to improving roads, modifying culverts for fish passage, closing roads, and restoring riparian areas. The primary opportunity for habitat improvement lies with private landowners, but management of public lands can be coordinated with the private sector to improve conditions in the analysis area.
When roads are needed to manage the resources in the analysis area (or for that matter, anywhere on public lands), they will need to be well placed and constructed where there is little to no impact to aquatic resources. All culverts installed on necessary roads will need to allow fish passage. All roads in this analysis area that are no longer in use should be decommissioned, but especially unused roads in unstable and riparian areas.

In some areas, the watershed is more sensitive than others. For instance, Mill and Rickreall creeks have a high proportion of sensitive hillslopes that have the potential to landslide. Soil surface erosion is a concern in the Mill, Rickreall, and Rowell subwatersheds. Mill, Rickreall, and Pedee creeks and the Luckiamute River (Little and Upper) are anadromous streams, and what private management does plays a significant role in protecting fish species and their habitat.

Management actions such as conifer stand establishment/development and riparian restoration are not believed to accelerate landslides and/or soil surface erosion in sensitive areas. These density management actions include planting and releasing conifers, and precommercial thinning. There is a need to avoid density management actions in sensitive areas that have the potential to increase landslides and/or soil surface erosion.

Little is known about historic trends and conditions for fish and their habitat in the analysis area. The conditions and trends of fish habitat are directly related to the streambed substrates, coarse woody debris in-stream, and the quality and quantity of pools at summer flow. Historic disturbances provided significant amounts of coarse woody debris which developed the fish habitat necessary for fish reproduction and population. However, timber harvest, splash dams, and the removal of large debris jams impacted fish habitat and caused conditions to become lacking in essential elements that provided a healthy environment for aquatic resources.

The Little Luckiamute River, along with the other subwatersheds in the megawatershed, flows into the Upper Willamette Evolutionarily Significant Unit (ESU). Spring chinook salmon and winter steelhead trout in the Upper Willamette ESU are proposed for listing as threatened under the Endangered Species Act. In addition, historical records show that Oregon chub were once present in the Little Luckiamute River, but today, the Oregon chub no longer exists in the analysis area. That these species are proposed for listing or extinct is evidence that the quality of habitat conditions in the analysis area has been greatly reduced.

Spring Chinook Salmon Trends:

! Recent totals of adult chinook that returned from the ocean and were counted at the Willamette Falls fish ladder averaged 26,000 in the Upper Willamette ESU. However, of this number, fish that actually entered a spawning area were estimated to average only 3,900; of these, only an estimated 1,300 were naturally produced (i.e., progeny of the naturally-spawning adults) in the wild.

! Degradation of spawning and rearing habitat; access to historic habitats is blocked by roads, culverts, and other unnatural structures that block fish access.

! Introduction of fall-run chinook salmon from outside of the ESU degrades the integrity of the spring chinook stock.

! A total harvest rate of approximately 60 percent contributes to the downward trend.

Winter Steelhead Trout Trends:

! In February 1998, NMFS proposed that Upper Willamette River steelhead be listed as threatened under the Endangered Species Act.

! Winter steelhead are in steep decline after exhibiting wildly fluctuating abundance. Returns of naturally-spawned adult fish in 1995 were the lowest in 30 years, and declines have been recorded in almost all natural populations.

! Natural winter steelhead population integrity is at risk from introduced summer steelhead.

FISH: Management Recommendations

! Collect existing fish/stream habitat inventory data from other agencies, and/or inventory streams on BLM lands in the Rowell and Lower Rickreall creek subwatersheds. Data on fish habitat are completely lacking for these two subwatersheds.

! Coordinate fish management activities with watershed councils and private landowners.

! Mitigate all management actions/projects that could cause water quality problems (sediment, temperature, etc.).

! Replace dysfunctional culverts and remove manmade barriers that prevent fish migration and continue to look for such barriers.

! Prioritize activities in riparian areas that will improve water quality.

! Re-establish conifers in the riparian zone where necessary.

! Identify roads for closure potential; determine the best method of closure on a case by case basis.

! Continue to investigate the possibility of improving fish habitat (restoration).

! When performing road maintenance, road decommissioning/obliteration, and culvert installation/replacement:

C Dispose of waste in stable sites only and outside of active 100-year floodplains
C Maximize maintenance activities during the dry season to avoid introducing sediment into the streams
C Stabilize potential erosion areas

- Do not create barriers to fish passage and remove all barriers where practical

WILDLIFE: Synthesis & Interpretation

The impacts of land ownership and land use during the past 150 years have significantly changed the landscape pattern, and thus the wildlife habitat, in the analysis area. The historic landscape originated primarily from episodic fire events which occurred every 200-400+ years. The current landscape originates from timber cutting events which occur about every 40-80 years. The landscape has become less stable since the rate of change has more than doubled (changed from 200+ years to 40-80 years), and because clearcutting has occurred in some wetter areas where fires historically may have been absent. Some effects of this instability can be seen in the increased abundance of red alder and other shade-intolerant species, and the increase in soil movement.

The historic late-seral/old-growth (LSOG) conifer forest matrix, estimated to have covered over 60 percent of the analysis area, has been reduced to scattered, isolated patches which make up 3 percent of the landscape (4,887 acres in 176 stands ranging from less than 1 to 304 acres). Not only have the two habitat types of the reference matrix been drastically reduced, but the matrix element itself has been lost as a result of a checkerboard and large patch ownership pattern that is complicated further by owners' different management strategies. The more porous (fragmented) landscape is a conglomeration of patches of different sizes, ages, and unnatural shapes (required by the straight lines of property boundaries). It has also become more fine-grained, with smaller and more numerous patches throughout. There is more edge, more high-contrast edge, and less interior-forest habitat of all types, with the most significant reductions in the late-seral and old-growth types (only 678 acres). A stable matrix would provide a high level of connectivity, or ease of movement, throughout the landscape. Today, connectivity in the analysis area has been greatly reduced for many species.

All existing LSOG habitat occurs on BLM lands, and current land use objectives on private lands will continue to maintain a patch element of early and mid-seral forests. The current condition of a matrix-less landscape is expected to continue until a significant reduction in the number of landowners occurs or a major land exchange effort is undertaken. The entire analysis area is designated as either LSR or AMA, so the trend over the next 100 years will show a slow but steady improvement in the quantity of LSOG habitat on BLM lands. Since the development of LSOG forest is concentrated on BLM lands, it will be limited in quantity (only 6.5% in the megawatershed and 18% in the analysis area) and quality (checkerboard land ownership pattern, poor connectivity, limited interior habitat possible) to levels well below historic.

The patch element has changed from a low density of large-sized early and mid-seral habitat patches with irregular boundaries to a high density of smaller patches with relatively uniform size and shape, but still dominated by early and mid-seral habitats. As stated above, the matrix element no longer exists but has been converted into the patch element. Some additional characteristics of patches in a landscape which originates from frequent timber harvest events (in contrast to infrequent, large-scale, episodic fire events) are as follows: younger, less plant species diversity; little or no coarse woody debris; more edge and more high-contrast edge; less interior forest habitat; and increases in shade-intolerant species.

Connectivity decreased as the landscape lost its matrix and became more fine-grained. The reference corridor element of streams and riparian zones also provided a level of connectivity throughout the analysis area that has been compromised during the past century. Compared to the reference condition instability created by fire, wind, and flood events, instability within the riparian/stream corridor system has increased as a result of road building, clearcutting, harvesting, and burning. Logging roads, an introduced corridor element, have increased access and connectivity to humans. (There are about four miles of roads per square mile of habitat in the analysis area.) This road system provides connectivity for some species but is a barrier for others.

Roads play an important role in the management of our natural resources: they allow access for harvesting forest products as well as for inventorying, monitoring, research, education, recreation, and fire management. The actual presence of well placed and constructed roads has little impact on wildlife habitat. (A mile of logging road, using 30 feet as an average width, converts about 3.6 acres of forest habitat; about 14 acres of habitat per 640 acres of forest [2.2%] has been lost to roads in the analysis area.) However, uncontrolled use of roads through or adjacent to Special Habitats or important breeding and foraging areas can be a disturbance to some wildlife, causing them to manifest atypical behavior. Continuous disturbance during critical times can impact reproductive success and species vigor.

The impacts to wildlife populations caused by vehicle-related injuries and/or death in the Oregon Coast Range are unknown. However, such impacts are expected to be minor due to the type of roads, their light use and a lack of any major elevational or latitudinal animal migrations. Roads are also used for poaching, especially big game, and can have a significant local impact on target populations and management efforts. A road-use plan, which should mitigate significant resource-road conflicts, is being developed for BLM roads in this analysis area.

Historic natural disturbance regimes of fire and wind left large amounts of dead woody debris and isolated individual and small patches of remnant LSOG trees throughout the forest ecosystem. Timber harvesting in the Pacific Northwest during the last 100 years has cleaned the forest of these Special Habitat Components (Maser et al. 1988). Most of the early and mid-seral habitat (97% of the analysis area) is deficient in historic levels of coarse, hard woody debris and remnant LSOG trees. This is both a current and long-term problem since it can take 100 years or more to develop these habitat components. Recruitment of this type of material will not be possible on private lands where stands are cut in the mid-seral age classes.

Since most Special Habitats in the Oregon Coast Range are a function of the landscape's geomorph-ology, the historic Special Habitats in this analysis area are expected to be present today and into the future. Little is known about the location or condition of many of these Special Habitats since a landscape level inventory has never been done. When any Special Habitat is found on BLM lands, its location and condition will be documented, and it will be managed to protect its unique values.

In general, the condition and trend of wildlife populations are directly related to the quantity and quality of available breeding and foraging habitats. Species diversity probably did not change significantly until the second quarter of this century. Around this time, as harvesting intensified and access by humans increased significantly, the matrix began to shift from LSOG to early/mid-seral patch habitat. Snags and down wood were salvaged or burned up, and the rate of disturbance (which changed from fire to timber harvest) went from 200-400+ years to about 40-80 years. The following habitats and the species which depend upon them have been significantly reduced and/or altered during the last 100 years of land-use activities:

- late-seral forest
- old-growth forest
- coarse woody debris
- large interior forest blocks of any habitat type
- riparian zones

Species which depend upon the following types of habitat may have increased in numbers since land management activities have favored their development:

- small to medium size (less than 1,000 acres) patches of any habitat type
- edge habitat
- early-seral forest
- mid-seral forest
- patches of different habitat types in close proximity

LSOG nesting and foraging habitat conditions for all of the Special Status Species listed in Chapter 3 of this analysis (see pp. R&CC-55-58) are expected to improve under the management guidelines for the LSR, AMA, and Riparian Reserves within the analysis area. If no management action is taken, LSOG forest acres will increase from 3 to 18 percent over the next eight decades. Under active management, actions will be taken in early and mid-seral habitats to accelerate the attainment of LSOG habitat conditions. This process might involve density management, underplanting, and creation of coarse woody debris and wildlife trees at different landscape levels and stand densities in locations where the highest success for achieving objectives is expected. Active management should provide more suitable LSOG habitat on a shorter time-frame than the "no management" alternative. Species requiring large amounts of unbroken LSOG forest may not respond to the improving conditions on BLM lands since these lands are scattered throughout the analysis area.

Habitat conditions for all big game species should become more stable as all the BLM forest matures into late-seral and old-growth habitat. The checkerboarded federal/private land ownership patterns and moderate amount of BLM acres in the analysis area will provide a suitable mix of seral stages for breeding, foraging, resting/hiding, and thermal cover to meet the needs of these species.

WILDLIFE: Management Recommendations

Priority 1.

Accelerate, in 40-110 year old stands (in both riparian and upland forest habitats), the attainment of large trees with large horizontal branches in order to provide increased nesting opportunities for marbled murrelets in the shortest time possible. Beginning with the oldest stands first, locations for treatment should occur in stands as follows: those closest to Coast; then those closest to existing occupied stands; and then those closest to existing unoccupied LSOG. [Note: This recommended action will also benefit LSOG-dependent species by accelerating the development of structural complexity and increasing the amount of it in these treated stands.]

Priority 2.

Survey all existing suitable marbled murrelet habitat to determine use in the analysis area. Survey the best nesting habitat first, in a west-to-east priority.

Priority 3.

Improve connectivity in riparian and upland forest habitats for all LSOG dependent species. In a south-to-north priority, accelerate the attainment of LSOG forest characteristics through density management, coarse woody debris management (see Priority 1C below), and under-planting of shade-tolerant climax species. Priority for stand selection should be given to location rather than age-class. Try to increase interior forest habitat acres by working in stands which are adjacent to existing LSOG stands. In addition, consider land tenure adjustments to further facilitate improved connectivity. Use Land Tenure Zone 3 lands outside the megawatershed for exchange.

Priority 4.

Create Special Habitat Components (snags, coarse woody debris, wolf trees, multi-layered canopies) where and when appropriate in stands 40-110 years old in riparian and upland forest habitats. Inventory existing pre- and post-treatment Special Habitat Component conditions. In stands with an average DBH of 12 inches or more, use trees which are at least 12 inches in diameter to create snags, coarse down woody debris, and wolf trees if these special habitat components are lacking. Use "Strategy #2" from the *LSR Assessment for Oregon's Northern Coast Range Adaptive Management Area* (USDA, USDI 1997) as a guide for leaving snags and coarse woody debris. Consider under-planting in openings and heavily thinned areas if a two-story structure is lacking. In stands with less than an average DBH of 12 inches, wait until structure is larger, monitor and re-enter stand to create Special Habitat Components when appropriate ("Strategy #3," LSR Assessment).

Priority 5.

Exchange lands with Willamette Industries, Inc., in the Mill Creek watershed to block-up BLM ownership, thus creating larger patches of interior forest habitat. Choose to acquire sections which are adjacent to the largest stands of existing LSOG on BLM lands. Use Land Tenure Zone 3 lands outside the megawatershed for exchange.

Priority 6.

Inventory for Special Habitats and input locations as polygons into GIS. Manage all Special Habitats to protect their unique qualities as related to wildlife nesting and foraging.

HUMAN USES

COMMODITY FOREST PRODUCTS: Synthesis & Interpretation

Current land use allocations (see Chapter 1, p. C-5-9) directly impact the amounts and types of timber and special forest products that can be harvested while supporting goals set for other resource values. Identification of the ecological functions and processes forest stands are expected to support within these allocations will help to guide levels of appropriate harvest within the analysis area.

Late Successional Reserves (LSRs) within the Adaptive Management Area are federal lands managed to protect and enhance late successional and old-growth forest ecosystem conditions, and to provide potential habitat for species dependent on this type of ecosystem (*Salem District ROD/RMP* 1995). Experimental harvest or other management practices may be necessary here to attain the conditions desire for this LUA. In addition to density management of vegetation in plantations, there are a variety of other techniques that are appropriate to employ for restoration of habitat in the analysis area. Appendix VII synthesizes these techniques and relates them to the ecological component affected, and includes criteria used to identify early silvicultural treatment projects.

Adaptive Management Areas (AMAs) are managed to produce timber while also providing connectivity between LSRs, a variety of habitat and ecological functions, and early successional habitat (*Salem District ROD/RMP* 1995). Non-traditional harvest and management practices may be necessary here to attain the conditions desired for this LUA. Some AMA lands are associated with landforms that have a moderate to low susceptibility to landslides. Following site-specific evaluation, it may be appropriate to reduce the width of Riparian Reserves in these areas in order to provide a larger land base for sustainable commercial timber production. Aquatic Conservation Strategy objectives would dictate the ability to reduce Riparian Reserve boundaries.

Special Forest Product (SFP) harvests in the analysis area have been moderate. A significant harvest of chanterelle (*Cantharellus*) mushrooms occurs during the fall within the Upper Rickreall and Mill Creek subwatersheds. The harvest of chanterelles has been increasing significantly during the past two years while firewood cutting has been decreasing. The majority of mushroom contracts are being sold for relatively small quantities and for short durations. Salal and moss are also harvested but at a lower level within the analysis area.

There are no present research projects identified in the analysis area. Research projects (to study how ecological processes are affected by density management/habitat manipulation) are being conducted in adjacent watersheds at a increasing rate.

COMMODITY FOREST PRODUCTS: Management Recommendations

! Prioritize density management treatments in stands, including those in Riparian Reserves, to benefit wildlife and aquatic habitat. First priority targets would be the even-aged, densely-stocked stands (50 to 110 years) in the western portion of the Mill and Luckiamute subwatersheds. Second priority would be the younger stands (25 to 49 years), beginning in the same area. Density management activities and design would utilize the process described in the North Coast LSR Assessment (p. 85) and would also incorporate CWD objectives by implementing Strategies 1-4 as stated in Table 24 of the LSR Assessment.

! Conduct forest inventory exams in stands listed above to determine current conditions and how to design for desired characteristics.

! Propose density management projects which promote ecological values while meeting the relevant criteria for a timber sale. Projects should exhibit a high rate of success in promoting LSR objectives and producing an economically viable timber sale. Funding for the planning and completion of non-timber-type projects, such as restoration of snags and coarse woody debris to improve wildlife habitat, should be appropriated from the benefiting resource activity.

! Consider implementing innovative management techniques such as scenario 2 (see Appendix VII, "Appropriate Silvicultural Management Activities") on AMA lands to test new techniques for the enhancement of LSR habitat.

! During the issuance of SFP contracts and permits, provide educational materials to the contractors and permittees about the collection of SFP to promote the sustainability of particular products.

! Promote research within the analysis area, with first priority being AMA lands, followed by LSR and/or

Riparian Reserves. Assist researchers in the design, layout, data collection and monitoring of their projects as needed.

TRANSPORTATION: Synthesis & Interpretation

Roads are a result of the progression of development and forest management from the reference condition to the current condition. With the trend toward reduced federal harvests, deterioration of roads and their structures is occurring due to reduced funding and hence maintenance revenues. BLM timber sales have provided funds for some surface rock and replacing deficient culverts. Occasionally special funds are appropriated to maintain, upgrade, or decommission roads controlled by BLM (i.e., floods, Jobs-in-the-Woods, etc.). This method of upgrading will continue as opportunities arise. Since BLM controls only 16 percent of the transportation system in the analysis area, implementation of management recommendations by BLM is expected to have only a proportionate effect on mitigating most issues at the analysis area level.

One aspect of road management that may play a significant role in improving impacts related to fisheries and water quality is using improved design and installation methods to upgrade drainage structures that are currently undersized and/or deteriorating. (Note: When comparing the benefits of funding improvements in this analysis area versus those in drainages with significant anadromous fisheries, additional analysis should be undertaken to determine priorities.) Most new road construction needed to access LSR treatment units will likely be removed at completion of activities. Maintenance of the transportation system will continue to be a priority for it provides access to private land for timber harvesting and to BLM lands for recreation, and research, monitoring, and other management activities. Roads also provide access for illegal activities such as dumping, poaching, and general vandalism.

TRANSPORTATION: Management Recommendations

! Replace undersized and/or deteriorating drainage structures in permanent streams and give priority to those that are inhibiting fish passage. All proposed projects must meet state fish plan requirements, RMP guidelines, ACS objectives, and Best Management Practices. (See Appendix IX, "Road Project Recommendations")

! Provide maintenance on surfaces and drainage structures on roads needed for current and future access. Promote cooperative maintenance with private landowners.

! Close and/or decommission (i.e., treat culverts/fills to reduce sediment delivery, scarify and outslope roadbeds, build armored waterbars, seed disturbed areas) roads where access is not needed within the next 10 years and where they are contributing to resource damage (water quality, fisheries, wildlife).

! Surface dirt roads which are needed for access to current and future projects.

! Continue to identify areas that are used for dumps, shooting ranges, and general vandalism, then map and report them to the area engineer who will discuss them with private landowners to try to develop possible prevention measures. Implement these measures swiftly, using timber sale requirements or Jobs-in-the-Woods funds. Develop a plan to prioritize existing dumps to be cleaned up and implement the plan as funds become available.

RECREATION: Synthesis & Interpretation

The transportation system is used for a variety of recreational activities. Dispersed recreation activities such as fishing, hunting, primitive camping, and motorcycle and mountain bike use will likely increase and place greater demands on the resources of the analysis area.

Industrial landowners and the BLM are concerned with increases in dumping, vandalism, and target shooting. Unauthorized use is increasing throughout the analysis area; as a consequence, some private landowners are installing gates or blocking roads on their land.

RECREATION: Management Recommendations

- Install and maintain road signs on BLM-controlled or major access roads.

- Continue the contract with Polk County for the maintenance of Mill Creek Park.

- Sign a law enforcement agreement with the Polk County Sheriff to patrol the analysis area for illegal use.

IDT MANAGEMENT RECOMMENDATIONS

The following Management Recommendations were synthesized by the Watershed Analysis Interdisciplinary Team from the lists of resource specific recommendations given above which were compiled by each team specialist. These recommendations are considered by the IDT to be the most important ones for the analysis area. (Note: These recommendations include some specific inventories which the IDT felt were particularly needed, but do not include inventories required to comply with existing laws, regulations, and policies regarding Special Status Species and the clearance of proposed BLM activities.)

Recommendation: Enhance Late-seral & Old-growth Forest Characteristics

- A) Determine marbled murrelet use in the analysis area by **surveying all existing suitable marbled murrelet habitat**. Survey the best nesting habitat first, in a west-to-east priority.
  Inventory 40-110 year old riparian and forest upland stands to determine if they are developing **LSOG characteristics**, especially hard snags, hard coarse woody debris, wolf trees, and multi-layered canopies. Start with stands which are immediately adjacent to existing LSOG and work in a west-to-east and south-to-north priority.

  In stands 40-110 years (both riparian and upland forest habitats), accelerate in the shortest time possible the attainment of large trees with large horizontal branches (using density management and other treatments as may be appropriate) to provide increased **nesting opportunities for marbled murrelets**. Beginning with the oldest stands first, locations for treatment should occur in stands as follows: those closest to the Coast; then those closest to existing occupied stands; and then those closest to existing unoccupied LSOG. [Note: This recommended action will also have beneficial impacts on other LSOG dependent species by accelerating the development of structural complexity in these treated stands and increasing the amount of it.]

- B) Improve **LSR connectivity** in riparian and upland forest habitats for all LSOG dependent species.

In a south-to-north priority (as outlined in the *Late-Successional Reserve Assessment for Oregon's Northern Coast Range Adaptive Management Area* [USDA/USDI 1997a]), accelerate the attainment of LSOG forest characteristics through density management, coarse woody debris management (see below), and under-planting of shade-tolerant climax species. Priority for stand selection should be given to location rather than age-class. Try to increase interior forest habitat acres by working in stands which are adjacent to existing LSOG stands.

! C) Create, where and when appropriate in early and mid-seral stands, **Special Habitat Components** (snags, coarse woody debris, wolf trees, multi-layered canopies) in riparian and upland forest habitats. Inventory all stand modification activities for existing pre- and post-treatment Special Habitat Component conditions. In stands with an average DBH of 12 inches or more, use trees which are at least 12 inches in diameter to create snags, coarse down woody debris, and wolf trees if these special habitat components are lacking. Use "Strategy #2" from the *LSR Assessment for Oregon's Northern Coast Range Adaptive Management Area* (USDA, USDI 1997) as a guide for leaving snags and coarse woody debris. Consider under-planting in openings and heavily thinned areas if a two-story structure is lacking. In stands with less than an average DBH of 12 inches, wait until structure is larger, then monitor and re-enter the stand to create Special Habitat Components when appropriate ("Strategy #3," *LSR Assessment*).

Recommendation: Water Quality

! A) **Improve drainage systems** on roads by installing extra cross-drains, water bars and drain dips, and by outsloping. Analyze stream crossings to determine their potential and priority for upgrading to eliminate stream diversion potential. Upgrade where practical by construction of deep dips, armoring fill slopes and outsloping roadways. Determine the feasibility for upgrading stream crossing culverts for fish passage.

! B) During the TMO process, continue to **inventory and evaluate roads for risks** of contributing to cumulative effects to the aquatic ecosystem. Factors to consider include proximity to the riparian zone, hill-slope stability, transient snow zone TSZ, road maintenance and use, and age and construction methods. In general, Mill Creek and Upper Rickreall Creek have the greatest concentration of high risk roads. Road segments should be considered candidates for upgrading and/or decommissioning on a prioritized basis, with risk for cumulative effects as a primary consideration factor.

Recommendation: Forest Peak ACEC

! Initiate an IDT process to determine the importance and relevance of **expanding the boundary of Forest Peak ACEC** (currently 134 acres) to include the entire BLM parcel in which it is located. This additional 26 acres would increase the size of this ACEC to 160 acres and provide additional protection to the critical elements of this ACEC. It is recommended further that no non-emergency management actions be taken in these 26 acres until the IDT process has been completed.

Recommendation: Land Tenure

! Create a Salem District Land Tenure IDT to determine, at a Coast/Cascade Range province level, the best give-and-take exchange/disposal strategy for the District's 9,900 acres of **Land Tenure**

Zone 3 lands (*Salem District ROD/RMP*, USDI, BLM 1995). This analysis area is completely within Land Tenure Zone 2, except for 215 acres of Zone 3 lands. The team was unable to agree upon a land tenure strategy at the watershed level, but a majority of the team members felt that some blocking-up of lands in the Mill Creek watershed would improve the Bureau's ability to conduct ecosystem management.

Recommendation: Size of the Megawatershed Analysis

- Divide the current megawatershed into **two smaller analysis areas** by separating the Luckiamute watershed from the S. Yamhill/Mill/Rickreall complex. There is a significant difference in the geology of the two systems: parent material in the Luckiamute is sedimentary, while basalt underlies the watersheds to the north. This impacts hydrology, soils, and soil movement enough to justify the split in any further iterations of this megawatershed area.

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Appendices

List of Appendices

Appendix I. Seral Stage vs. Ownership

Table A.I.-1. Seral Stage & Ownership by Subwatershed

Note: Ages for seral stages are as follows: Early = 0-39 years, Mid- = 40-79 years, Late- = 80-199 years and Old-growth = 200+ years

Subwatershed: Clayton/Pedee

Seral Stage	Private Acres	BLM Acres	BLM ownership (%)
Early	8,109	1,212	13.00
Mid-	7,351	512	6.51
Late-	0	48	100
Old-growth	0	918	100
Hardwoods	383	107	21.84
Total	15,843	2,797	15.01

Subwatershed: Little Luckiamute

Seral Stage	Private Acres	BLM Acres	BLM ownership (%)
Early	14,872	136	0.91
Mid-	17,455	786	4.31
Late-	0	20	100
Old-growth	0	256	100
Hardwoods	889	51	21.84
Total	33,216	1,249	3.76

Subwatershed: Mill Creek

Seral Stage	Private Acres	BLM Acres	BLM ownership (%)
Early	11,726	5,062	30.15
Mid-	8,524	5,193	37.86
Late-	0	345	100
Old-growth	0	1,289	100
Hardwoods	1,671	283	14.48
Total	21,921	12,172	35.70

Subwatershed: Rickreall

Seral Stage	Private Acres	BLM Acres	BLM ownership (%)
Early	2,828	510	15.28
Mid-	6,821	269	3.79
Late-	0	63	100
Old-growth	0	0	0.00
Hardwoods	137	0	0.00
Total	9,786	842	7.92

Subwatershed: Rowell

Seral Stage	Private Acres	BLM Acres	BLM ownership (%)
Early	5,055	1,306	20.53
Mid-	3,844	1,333	25.75
Late-	0	50	100
Old-growth	0	396	100
Hardwoods	56	31	35.63
Total	8,955	3,116	25.81

Subwatershed: Upper Luckiamute

Seral Stage	Private Acres	BLM Acres	BLM ownership (%)
Early	11,600	876	7.02
Mid-	5,869	1,068	15.40

Late-	**0**	**277**	**100**
Old-growth	**0**	**1,087**	**100**
Hardwoods	**94**	**111**	**54.15**
Total	**17,563**	**3,419**	**16.2**

Subwatershed: Upper Rickreall

Seral Stage	**Private Acres**	**BLM Acres**	**BLM ownership (%)**
Early	**4,184**	**946**	**18.44**
Mid-	**4,684**	**961**	**17.02**
Late-	**0**	**80**	**100**
Old-growth	**0**	**58**	**100**
Hardwoods	**0**	**49**	**100**
Total	**8,868**	**2,094**	**19.10**

Appendix II. Rural Interface Areas

Rural Interface Areas (RIAs) are BLM-administered lands adjacent to or intermingled with private lands which are either zoned for development for rural residences or already developed with rural residences. RIAs are found throughout the lower elevations of the analysis area (see Map 8, p. C-12). Most are along county and industrial forest roads in the narrow valleys which extend into the Coast Range foothills. Although many families want to live in rural settings, much of the analysis area is unavailable for residences, being farmland or else forest owned by the State, federal government or timber companies.

There are approximately 600 acres of BLM land located within the 1/4 mile zone and 1,090 acres within the ½ mile zone (*Salem District ROD/RMP*).

This use is a concern to BLM for three major reasons:

1. Homes and lot sizes impede efficient management of BLM-administered forest lands.
2. Some RIA property owners, especially full-time residents, object to forest management activities and public uses, and take actions to stop or change these activities and uses.
3. The cost of wildfire suppression is greatly increased when dwellings are present.

Based on these concerns, management actions and directions for BLM-administered lands in RIAs were developed (see *Salem District ROD/RMP*, p. 39). The essence of this guidance is reflected in the following RIA objective:

> "Consider the interests of adjacent and nearby rural land owners, including residents, during analysis, planning and monitoring of projects and activities in rural interface areas. These interests include personal health and safety, improvements to property, and quality of life. BLM will determine how land owners might be or are affected by activities on public lands."

Major RIAs in the analysis area are:

- Mill Creek and Gooseneck Creeks: a small number of people live in these drainages, with some residences adjacent to timbered areas.

- North and South Forks of Pedee Creek: a small population exists, mainly located in the narrow valley bottoms.

Management Concerns

Adjacent or Nearby Landowners

- Mill Creek: One homeowner has expressed concerns over vandalism occurring on BLM land, e.g., illegal shooting and timber theft.

- Gooseneck Creek: Approximately 15 years ago, one resident successfully challenged the BLM in court concerning sedimentation entering a pond following timber harvesting and road construction activities on BLM land.

Tribal Interests

Contact was made with the Confederated Tribes of the Grand Ronde Indians of Oregon with respect to their current interests or concerns in the watershed (Cliff Adams, personal contact). No major interests or concerns were expressed, but they requested a copy of the final analysis.

Appendix III. Erosional Processes

The analysis area occurs in a temperature and precipitation zone that favors mass wasting (or landsliding) as the most important erosional process. Most of the sub-watersheds were, and continue to be, formed by broad-scale uplifting and mass-wasting events which have occurred over many thousands of years. Two types of landslides occur in the watershed: debris avalanches and rotational slumps.

Debris Avalanches

Mass wasting by debris avalanching is the most catastrophic producer of sediment in the watershed; it occurs primarily in head walls, and on convex portions of resistant parent materials on hill-slope gradients steeper than 60%. Steeper slopes and a larger source area above the head wall typically increase failure rates, i.e., reduce the return interval time between successive failures of a given head wall. Avalanche events are sudden and triggered by high precipitation events (usually > 5 inches in 24 hours) which result in full saturation of the soil profile. The risk of avalanche events is higher in steep areas undergoing a loss of support; such loss of support results from deterioration of tree roots following death from intense fire, lowdown, timber harvest, insects, disease, etc. Over several decades, as trees re-establish on these sites, the risk of avalanche failure lessens.

The area of soil lost from avalanches is usually less than 0.5 acre. Avalanche materials generally move into depositional areas along second- or third-order streams. Such materials can temporarily dam streams and influence the condition and functioning of adjacent riparian zones. Avalanches are an important source of gravel and coarse woody debris for stream systems.

Rotational Slumps

Mass wasting by rotational slump earth-flows occurs in deep soils over thin, bedded sandstone and silts tone. These formations are permeable to water that allows deep weathering of soil parent material. Slump earth-flows are features that cover many acres of land and are typically found on hill-slopes of undulating topography (caused by previous slumps), with gradients less than 60%. The process begins by down-slope creep and distortion of the soil mass. This in turn disrupts the natural drainage within the soil mass, which increases water in the slide material, speeding creep rates. Slope failure or slumping can be initiated when soil-pore water pressure increases in the toe of the slide (due to saturated conditions causing: 1) a reduction in soil cohesiveness and 2) increased lubrication at the contact zone), and/or when soil weight above the toe reaches a critical level. Sliding hazard is increased by:

1) Processes that contribute to wet soil conditions in slump areas, for example:

- High precipitation due to climatic/seasonal influences.
- Road construction or other practices that catch and divert additional water onto slump areas.
- Reducing the rate of water removal by transpiration from vegetation as a result of mechanical, climatic, and/or biological factors (e.g., logging, windthrow, and disease). [This effect is minor since most soil creep occurs during the wet season (winter/early spring) when transpiration rates are very low anyway.]

2) Processes that reduce the support provided by the toe of the slump area, for example:

- Undercutting and removing material from the toe area of the slump by road or landing construction, or by stream erosion of banks that are toes of slumps.

3) Increasing the weight of material in a slump prone area, for example:

- Placing large fills or excavated waste material on slump areas.

Slump-earth flows tend to occur on the more productive sites (due to the deep soils and available water). Slumps affect type of vegetation on the site (due to moisture/drainage effects) and have a high impact on tree-bole straightness. When slumps reach streams, they become a chronic source of sediments.

The high site productivity generally associated with slump prone areas makes them good areas for timber production. The limiting factor would be if the rate of soil creep results in excessive form damage to trees (excessive sweep or crooks). Shortened rotations may be necessary to minimize these effects.

Dry-raveling

Dry-raveling of loose materials is primarily a physical hill-slope process that moves materials down-slope and delays vegetative regrowth. Dry-raveling is a mechanical process in which materials are detached from the hill-slope (primarily by wetting-drying or freeze-thaw action) and move down-slope into concave positions. This process is slope driven (i.e., dry ravel rates become significant as slope angle increases above 60-70%). Areas at high risk for dry-raveling can be delineated by assessing local topography, vegetation cover and soil types.

Concave hill-slope positions accumulate materials from dry-raveling. These materials later become gravelly, highly productive soils. In contrast, convex slopes are net losers of soil material, and thus contain rock outcrops and soils with thin surface layers and shallow depths. These shallow soils support little vegetative cover, and are subject to surface erosion from overland flow, the major erosive process on stable hillslopes less than 60%. Loss of vegetative cover by fire or removal increases the erosion hazard.

Appendix IV. Natural Fire Processes

The natural fire regime for the northern portion of the Oregon Coast Range is one of severe fire events that were very infrequent, returning at irregular intervals of 150 to 400 years or more (Agee 1993). These intense fires would likely consume several thousand and possibly hundreds of thousands of acres. Generally, individual trees, groups of trees, and even large forest patches would survive these fires, although the distribution of surviving vegetation on the landscape would vary widely.

Survival and Regeneration

There are many factors that influence how vegetation survives a fire. Among these factors are the following: pre-fire stand fuel composition; time of day, weather, and micro-climatic conditions at the time of the fire; and local topography. The amount and distribution of this surviving vegetation plays a key role in the rate of reforestation and in the species distribution in the succeeding stand. Following a major fire event, there could be great difficulty in naturally reseeding large areas devoid of a seed source. This has been confirmed in an early USGS report from the Coast Range that states, "Areas are reported which were burned twenty-five to fifty years ago on which there is no vegetation larger than brush and ferns, trees of any species not yet having obtained a foothold." (Gannett 1902)

A preliminary study of stumps in recently logged, older stands in the northern Coast Range is currently under way. Information obtained thus far indicates that in many of these natural stands, the initial tree-stocking levels were quite low. For many stands studied, the growth pattern during the first 50-to-100 years, as expressed by the tree rings, shows very rapid growth similar to that of open grown trees. Furthermore, the study is showing the spacing of the largest (and usually oldest) stumps to be quite wide, similar to that found in many old-growth stands. Several distinct or multiple-age groupings in the smaller (usually younger) stumps are commonly found. It is thought that these smaller trees filled in the canopy gaps created by mortality of older trees caused by wind throw, subsequent fires, and disease. This may change our definition of "even-aged" stands a bit: perhaps our concept for the stands we now commonly refer to as "even-age" needs to allow for a longer period of stand establishment and a broader range of tree ages.

Very little is known about the frequency and extent of lower intensity fires (referred to as "under- burns") in the northern Coast Range (Walstad et al. 1990). Because they are undramatic, few detailed historic accounts of low-intensity fires exist. Within a few decades following a low-intensity fire, there is little definitive physical evidence remaining to help date the occurrence(s) and determine the frequency or intensity of such events.

The influence of on-shore flow of marine air masses creates a predominantly cool and moist climate in the Coast Range, making the incidence of lightning strikes in this region one of the lowest in North America. This prevailing climatic condition is the primary reason for the infrequent nature of both major fires and underburns. It is hypothesized that human-caused ignitions played a more significant role in fire occurrence in the Coast Range compared with other areas of the state (Teensma et al. 1991).

Native Americans and Fire

The Native American use of fire in the Willamette Valley is well documented (Boyd 1986, Zybach 1988, Agee 1993). Boyd has reconstructed a probable burning schedule for the Kalapuya:

> In late Spring and early Summer the Indians were probably concentrated at "primary flood plain" sites in the wet prairies where root crops such as camas were collected and processed. There was no burning at this time. During mid-summer (July and August), the focus shifted to the dry prairies, so the "narrow valley plain" sites were more intensively occupied. Burning in July and August was apparently sporadic, most likely occurring after the harvest of seasonally and locally available wild foods (grass seeds, sunflower seeds, hazelnuts and blackberries) in limited areas. The immediate effect of the early burns would be a "cleaning up" process; the long-term result would be to facilitate the re-growth, in future seasons, of the plants involved. In late summer, fire was used on the high prairies, as a direct tool in gathering of tarweed and insects. This was followed, in October after acorns had been collected, by firing of the oak openings. Finally, from the "valley edge" sites, the Kalapuya initiated large-scale communal drives for deer, which provided a winter's supply of venison. The sequence ended as they returned to their sheltered winter villages along the river banks.

If late summer and fall fires were ignited prior to the onset of strong east winds, it seems very likely that such fires would have burned up into the higher elevations of the Coast Range (Ripple 1994, Teensma et al. 1991). Pushed by a strong east wind following a very dry summer, it is not difficult to envision a late summer fire, started at a valley margin site, burning well into the interior of the Coast Range before weather conditions changed and halted its advance.

Historic Fire Patterns

Historic fire patterns, and their effects on the landscape pattern of the Coast Range, have become an item of considerable interest to many authors (Zybach 1988, Walstad et al. 1990, Teensma et al. 1991, Agee 1993, Ripple 1994). The information provided by these authors, as well as forest inventory data collected by BLM, allows a picture to be roughly pieced together of how recent historic fires influenced relevant Coast Range watersheds. For example, a very large wild fire, or a series of fires, burned approximately 480,000 acres of the central Coast Range in the period between 1853 to 1868. The Yaquina Fire, as it is called, burned a huge area between present day Corvallis to Yaquina Bay (Gannett 1902, Walstad et al. 1990, Teensma et al. 1991). It is believed that this fire resulted from homesteading activity. During that time, it is possible that new starts or holdover fires from a previous year broke out anew in the summer and burned additional acreage (Gannett 1902; Walstad et al. 1990). Historical accounts from the Yaquina fire period tell of people having to "eat their noon day meals by candle light"; and of people describing "It was dark all over for about 10 days," and "the world in flames" (Zybach 1988). Historic fire patterns are important in understanding the current landscape pattern and in envisioning a possible scenario for the future.

APPENDIX V. Riparian Reserve Project Design: Factors to Consider

- Management objectives for a proposed restoration project should be based on the physical and biological potentials and the geomorphic context of the site. The geomorphic context should be field-investigated, and an explanation of its significance to the site's physical and biological processes should be addressed in the EA. This description should include an estimate of the extent of true riparian zone (i.e., the stream-adjacent zone that directly influences conditions in the aquatic environment; conifers should not be planted, for example, in a floodplain with a high water table) as distinguished from the uplands that lie within the Riparian Reserve area.

  Factors to consider when distinguishing the uplands from the true riparian include:

  - Slope breaks: those points on the slopes where erosional processes have produced over-steepened and actively eroding surfaces that contribute sediment directly to the channel and/or floodplain

  - Geomorphic type: floodplains, terraces, alluvial-colluvial fans, debris torrents, in-channel landslide deposits, streambanks and vertical canyon walls ("gorges") are all considered to influence aquatic conditions actively and directly, and therefore are part of an ecological riparian zone. In contrast, a stable colluvial hillslope, bench or ridge line is considered upland.

  - Water table: as evidenced by the site's plant communities and physical conditions

  - Stream channel type: steep, intermittent "source" stream, or low-gradient, depositional reach

- Upland sites within the Riparian Reserve allocations are transitional, and their direct influence on aquatic conditions quickly approaches a limit where management activities carry small potential, or risk, for affecting the aquatic system. How quickly this limit is approached varies by issue (i.e., stream temperature vs. sediment supply) as well as spatially and temporally. This should be recognized in project planning by addressing these specific effects at the project level.

- Since standards and guidelines for a properly functioning riparian zone have not been well quantified, they need to be developed on a site-specific basis. For the true riparian zone, reference sites should be identified that can serve as a model for how it is thought the site in question should or could function. This would help define the "range of natural variability" for the site. Where no adequate reference site can be identified, "professional judgement," buttressed by relevant research and reference work together with evidence from the site in question, should be relied upon.

- Treatment prescriptions should include all subsequent treatments necessary to achieve older forest characteristics, ACS objectives and coarse woody debris (CWD) goals for the stand. Monitoring must be specifically identified to insure that it is completed and the results are incorporated into future planning.

- Major riparian vegetation functions which need to be addressed when assessing project level conditions are listed below (Table A.V.-1.).

Table A.V.-1. Riparian Reserve Functions and the Role of Vegetation

Riparian Vegetation Function	Requirements for Proper Function
Shade: C regulates in-stream temperatures for fish, amphibians, & invertebrates C regulates terrestrial microclimate	C large trees and other vegetation with high % canopy closure
Allochthonous* input: C food resource for invertebrates & microbes (99% in first-order streams)	C diverse species of trees and other vegetation
CWD source: C provides habitat for fish, amphibians, invertebrates, beaver, fungi, and bryophytes C helps frame stream channel morphology	C mature and understory conifers in abundant supply and well distributed
Nutrient/sediment filter: C maintains high water quality	C periodic inundation of floodplain provided by connectivity of floodplain and stream (promotes denitrification) C trees and other vegetation to trap sediment
Habitat/dispersal corridors: C provides cover, forage, water C provides connectivity to dispersal areas within and between watersheds	C mature to late-seral forest characteristics
Bank stability: C lowers erosion potential C maintains high water quality	C trees and other vegetation with good root strength
Energy dissipation: C lowers erosion potential C builds floodplains C maintains high water quality	C CWD in channel and on floodplain C streamside trees and other vegetation C connectivity of stream and floodplain (floodplain inundated every 1-3 years)

* Material — leaves, needles, seeds, etc. — produced outside the stream but which falls into it as a food source.

Appendix VI. Special Status Species Summary and Table for Terrestrial Wildlife in the Marys Peak Resource Area, Salem D.O., B.L.M.

This summary is based upon policy and guidance provided by the following documents: 1) **Northwest Forest Plan ROD/Standards and Guidelines**; 2) **BLM Manual Sec. 6840 - Special Status Species Management**; 3) **Oregon/ Washington Special Status Species Policy** (BLM IM OR 91-57, Nov. 5 1990); and 4) **Salem District ROD/Resource Management Plan/FEIS**. The structure and language used in this summary to categorize and label species groups is taken directly from these documents and should be used in all wildlife analyses such as Biological Evaluations, Biological Assessments, and Watershed Analyses. This summary was last revised on **February 3, 2000** and will be updated as species/categories are added/ removed/changed. **Bolded species** are known or suspected to occur on BLM lands within the Resource Area (RA) boundary.

I. NORTHWEST FOREST PLAN SPECIES DESIGNATIONS

A. Riparian Reserve (pp. B-13, D-10)

"...species that were intended to be benefited by the prescribed Riparian Reserve widths...fish, mollusks, amphibians, lichens, fungi, bryophytes, vascular plants, American martens, red tree voles, bats, marbled murrelets, and northern spotted owls."

Any action that would alter existing habitat conditions within Riparian Reserves (RRs) or change the width of RRs requires an impacts analysis (within the WA) be completed for this group of species.

Mollusks:	**All Mollusks** in RRs in the RA
Amphibians:	**All Amphibians** in RRs in the RA
Birds:	**Marbled Murrelet**
	Northern Spotted Owl
Mammals:	**American Marten**
	Red Tree Vole
	All Bats in RRs in the RA

B. Survey and Manage (pp. C-4 to -6, and Table C-3, pp. C-49 to -61)

Survey protocols and management recommendations are available for the red tree vole and the three mollusks which occur in the RA. All actions must be surveyed prior to disturbance. Mollusk surveys require two visits with at least one being in the fall.

Additional species analyses can be found in Appendix J2, FSEIS on *Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl*.

Mollusks:	43 species listed (pp. C-59, 60)
	Oregon Megomphix Snail (*Megomphix hemphilli*)
	Blue-grey Tail-dropper Slug (*Prophysaon coeruleum*)
	Papillose Tail-dropper Slug (*Prophysaon dubium*)
Mammals:	**Red tree vole** (p. C-59)

C. Protect Sites From Grazing (p. C-6)

Mollusks: 10 species listed; none in RA

D. LSR Protection Buffer (pp. C-11, 19)

Amphibians: 1 species listed; not in RA
Birds: 1 species listed; not in RA

E. Matrix and AMA Roost Sites For Bats (pp. C-43, 44, D-10, 11)

Large snags and decadent trees in the LSR are expected to meet the needs of most of the cavity and crevice roosting bats in the Marys Peak RA. The following additional protection was deemed necessary outside LSR forests.

1. Caves

Known occupied caves/mines should be protected with a 250 foot buffer in all land use allocations; primary species of concern is **Townsend's Big-eared Bat**. Conduct surveys to determine occupancy if unknown.

2. Abandoned Wooden Bridges and Buildings

Conduct surveys to determine occupancy by bats. Primary species of concern are as follows: **Fringed Myotis**, **Silver-haired Bat**, **Long-eared Myotis**, **Long-legged Myotis**, and the **Pallid Bat**. All these species occur in RA except the pallid bat. Occupied sites need a 250 foot buffer.

F. Matrix Protection Buffer (p. C-45)

Mollusks: 10 species listed; none in RA
Birds: 4 species listed; none in RA (pp. C-45, 46)
Mammals: 1 species listed; not in RA (pp. C-47, 48)

II. USDI BLM MANUAL SEC. 6840 SPECIES DESIGNATIONS (Sec. 6840.01)

A. Federally Listed Threatened and Endangered (Sec. 6840.06A)

"The BLM shall conserve T/E species and the ecosystems upon which they depend and shall use existing authority in furtherance of the purposes of the Endangered Species Act (ESA)...Ensure that all activities authorized, funded, or carried out by the BLM are in compliance with the ESA...Cooperate with the FWS/NMFS in planning and providing for the recovery of T/E species."

Arthropods: **Oregon Silver Spot Butterfly**: Threatened
Birds: **American Peregrine Falcon**: Endangered
Bald Eagle: Threatened
Marbled Murrelet: Threatened
Northern Spotted Owl: Threatened

B. Proposed For Federal Listing (Sec. 6840.06B)

"Species proposed for listing as T/E shall be managed with the same level of protection provided for T/E species except that formal consultations are not required."

There are, as of **February 3, 2000**, no Proposed for federal listing species which occur in the RA.

C. Candidate (Sec. 6840.06C)

"The BLM...shall ensure that actions authorized, funded, or carried out do not contribute to the need to list any of these species as T/E."

There are, as of **February 3, 2000**, no Candidate species which occur in the RA.

D. Sensitive (Sec. 6840.06D)

"State Directors, usually in cooperation with State wildlife agencies, may designate sensitive species. By definition the sensitive species designation includes species that could easily become endangered or extinct in a State. Therefore, if sensitive species are designated by a State Director, the protection provided by the policy for candidate species shall be used as the minimum level of protection." See section **III. OR-WA Special Status Species Policy Designations**, part **A. Bureau Sensitive**, for a list of species in this category.

E. State Listed (Sec. 6840.06E)

"The BLM shall carry out management for the conservation of State listed plants and animals. State laws protecting these species apply to all BLM programs and actions to the extent that they are consistent with FLPMA and other Federal laws."

Birds:	**Marbled Murrelet**
	American Peregrine Falcon
	Bald Eagle
	Northern Spotted Owl
Mammals:	**California Wolverine**: Threatened (may occur in the RA based on 2 questionable sightings from the Coast Range)

III. OREGON-WASHINGTON SPECIAL STATUS SPECIES POLICY DESIGNATIONS (IM-OR-91-57, Nov. 5, 1990)

" ...the State Director is designating sensitive species for Oregon and Washington under the category 'Bureau Sensitive' plus establishing two additional categories of plant and animal species... 'Assessment' and 'Tracking'..." Invertebrates were added to the policy in 1991 (IM-OR-91-290, April 18, 1991).

A. Bureau Sensitive (Taxa included = ONHP List 1 and State Director approved nominations)

This list is defined in Bureau Manual Section 6840. See section **II. USDI BLM Manual Sec. 6840 Species Designations**, part **D. Sensitive** above.

Annelids:	**Oregon Giant Earthworm**
Mollusks:	**Oregon Megomphix Snail**
Arthropods:	**American Acetropis Grass Bug**
	Taylor's Checkerspot Butterfly
	Mary's Peak Ice Cricket
	Insular Blue Butterfly
	Roth's Blind Carabid Beetle
Birds:	**Northern Goshawk**
Mammals:	**Fringed Myotis**

B. Assessment (ONHP List 2 and ODFW Sensitive Species List "Peripheral or Naturally Rare")

In Oregon and Washington "**Assessment Species**" are considered "**Special Status Species**" as defined in Bureau Manual 6840 (Attachment 2, p. 1 of IM-OR-91-57).

Mollusks:	**Papillose Tail-dropper Slug**
Arthropods:	**Foliaceous Lace Bug**
	Lygus Oregon Bug
	Hoary Elfin Butterfly
	Valley Silverspot Butterfly
Amphibians:	**Clouded Salamander**
	Tailed Frog
Reptiles:	**Painted Turtle**
	Northwestern Pond Turtle
	Sharptail Snake
Birds:	**Northern Saw-whet Owl**
	Pileated Woodpecker
	Harlequin Duck
	Purple Martin
	Western Bluebird
Mammals:	**Townsend's Big-eared Bat**
	American Marten
	Fisher

C. Tracking (ONHP List 3 and 4, and ODFW Sensitive Species List "Undetermined Status")

"Until the status of such species changes to federal or state listed, candidate or assessment species, 'tracking species' will not be considered as special status species for management purposes."

Arthropods:	**True Fir Pinalitus Bug**
	Douglas-fir Platylygus Bug
Amphibians:	**Western Toad**
	Red-legged Frog
	Southern Seep/Torrent Salamander
Birds:	**Willow Flycatcher**
	Northern Pygmy Owl
Mammals:	**White-footed Vole**
	Silver-haired Bat
	Long-eared Bat
	Long-legged Bat
	Yuma Bat

IV. SALEM DISTRICT ROD/RMP AND PRMP/FEIS SPECIES DESIGNATIONS

A. SEIS Special Attention (*Salem District ROD/RMP*, p. 8)

The Northwest Forest Plan "...provides management guidance for a specific list of plant and animal species which are or may be found in the major land allocation areas. In this RMP these species are referred to as 'SEIS Special Attention Species.' Management guidance is separated in two categories- 'Survey and Manage' and 'Protection Buffers.' " See section **I. Northwest Forest Plan Species Designations** above.

B. Special Status (Salem PRMP/FEIS, pp. 3-36)

The Salem PRMP/FEIS identifies Special Status Species as the following: Federally Threatened, Endangered, Proposed and Candidate; State-listed Threatened or Endangered; Bureau Sensitive; and Bureau Assessment. See sections **II. USDI BLM Manual Sec. 6840 Species Designations**, and **III. Oregon-Washington Special Status Species Policy Designations** above, for a listing of these designations and the species that occur in the RA.

C. Priority (Salem PRMP/FEIS pp. 3-36; BLM M 6840.06C2a.; BLM MS 1622.11A1)

"This section covers other priority species including important game species and other species considered vulnerable to impacts from forest management."

Amphibians:	**All** occurring in RA
Birds:	**All Raptors** occurring in RA (*Salem District ROD/RMP*, p. 26)
	Great Blue Heron (*Salem District ROD/RMP*, p. 26)
	Neotropical Migrants
	Ruffed Grouse
	Blue Grouse
	Wild Turkey
	California Quail

Mountain Quail
Band-tailed Pigeon
Mourning Dove
Hairy Woodpecker
Downy Woodpecker
Red-breasted Sapsucker
Northern Flicker

Mammals: **Black Bear**
Black-tailed Deer
Mountain Lion
Roosevelt Elk (*Salem District ROD/RMP*, p. 26)

Table A.VI.-1. Special Status Species Summary, Marys Peak Resource Area

SPECIES DESIGNATIONS = **RR**-Riparian Reserve; **S&M**-Survey & Manage; **BRS**-Bat Roost Sites; **FE**, **FT**, **FPE**, **FPT**, **FC**-Federal Endangered, Threatened, Proposed Endangered, Proposed Threatened, Candidate; **SL**-State Listed; **BS**, **BA**, **BT**-Bureau Sensitive, Assessment, Tracking; **SA**-Special Attention; **SS**-Special Status; **P**-Priority

SPECIES	NFP (Regional)	BLM 6840 (National)	OR-WA SSS (State)	SALEM RMP (District)
I. ANNELIDS				
Oregon Giant Earthworm			BS	SS
II. MOLLUSKS				
All	RR			
Oregon Megomphix Snail	S&M		BS	SA, SS
Papillose Tail-dropper Slug	S&M		BA	SA, SS
Blue-Gray Tail-dropper Slug	S&M			SA
III. ARTHROPODS				
American Acetropis Grass Bug			BS	SS
Taylor' s Checkerspot Butterfly			BS	SS
Mary' s Peak Ice Cricket			BS	SS
Insular Blue Butterfly			BS	SS
Roth' s Blind Ground Beetle			BS	SS
Foliaceous Lace Bug			BA	SS
Lygus Oregon Bug			BA	SS
Hoary Elfin Butterfly			BA	SS
Valley Silverspot Butterfly			BA	SS
True Fir Pinalitus Bug			BT	P
Douglas-fir Platylygus Bug			BT	P
IV. AMPHIBIANS				
All	RR			P
Clouded Salamander			BA	SS
Tailed Frog			BA	SS
Western Toad			BT	P
Red-legged Frog			BT	P
Southern Seep/Torrent Salamander			BT	P

SPECIES	NFP (Regional)	BLM 6840 (National)	OR-WA SSS (State)	SALEM RMP (District)
V. REPTILES				
Painted Turtle			BA	SS
Northwestern Pond Turtle			BA	SS
Sharptail Snake			BA	SS
VI. BIRDS				
Marbled Murrelet	RR	FT, SL		SS
Northern Spotted Owl	RR	FT, SL		SS
Bald Eagle		FT, SL		SS
Northern Goshawk			BS	SS
Northern Saw-whet Owl			BA	SS
Pileated Woodpecker			BA	SS
Purple Martin			BA	SS
Western Bluebird			BA	SS
Northern Pygmy Owl			BT	P
Neotropical Migrants				P
All Raptors				P
Great Blue Heron				P
Ruffed Grouse				P
Blue Grouse				P
Wild Turkey				P
California Quail				P
Mountain Quail				P
Band-tailed Pigeon				P
Mourning Dove				P
Hairy Woodpecker				P
Downy Woodpecker				P
Red-breasted Sapsucker				P
Northern Flicker				P

SPECIES	NFP (Regional)	BLM 6840 (National)	OR-WA SSS (State)	SALEM RMP (District)
VII. MAMMALS				
American Marten	RR		BA	SS
Red Tree Vole	RR, S&M			SA
All Bats	RR			
Fringed Myotis	BRS		BS	SA, SS
Silver-haired Bat	BRS		BT	SA
Long-eared Bat	BRS		BT	SA
Long-legged Bat	BRS		BT	SA
Yuma Bat			BT	p
White-footed Vole			BT	p
Black Bear				P
Black-tailed Deer				P
Mountain Lion				P
Roosevelt Elk				P

SPECIES DESIGNATIONS = **RR**-Riparian Reserve; **S&M**-Survey & Manage; **BRS**-Bat Roost Sites; **FE**, **FT**, **FPE**, **FPT**, **FC**-Federal Endangered, Threatened, Proposed Endangered, Proposed Threatened, Candidate; **SL**-State Listed; **BS**, **BA**, **BT**-Bureau Sensitive, Assessment, Tracking; **SA**-Special Attention; **SS**-Special Status; **P**-Priority

Changes Since the Last Revision:

1. **Fender's Blue Butterfly** removed from list due to lack of significant host plant populations in the upland forest environment; primarily a valley bottom and fringe species.

2. **Northern Goshawk** upgraded from Bureau Assessment to Bureau Sensitive as per I. M. No. OR-98-012.

3. **Oregon Spotted Frog** removed from list due to lack of significant habitat in upland forest environment: this frog strongly prefers warm, still waters for breeding; our waters are too cold.

Note: This table was updated on May 15, 1998.

Appendix VII. Appropriate Silvicultural Management Activities

Regional Ecosystem Office (REO) guidelines for silvicultural treatments in both precommercial thinning and commercial thinning age classes emphasize the need to maintain diversity in meeting Adaptive Management Area (AMA), Late-Successional Reserve (LSR), and Riparian Reserve (RR) objectives, including leaving some areas untreated. This is particularly important when determining the primary needs for treatment within AMAs, LSRs, or RRs, and to evaluate the future outcome of stands by "keeping all the pieces."

Although the majority of the watershed is in LSR, forest management must still be pursued if long-term objectives are to be met and the attainment of those objectives is to be accelerated to the highest degree possible. Justification for this assumption is described in the following section.

The *Northern Late Successional Reserve Assessment* (NLSRA 1997) determined that given the high density and predominant monoculture of trees in the managed plantations on federal land, several management options are appropriate and desirable to accelerate the attainment of late-successional characteristics. It also proposed that treatments in the LSR would be both inside and outside of Riparian Reserve boundaries, since many objectives for LSRs are similar to those for Riparian Reserves. These objectives include:

- thinning to control density and produce desirable characteristics
- underplanting with shade-tolerant species
- selecting for both species and structural diversity
- developing prescriptions that are ecologically based, i.e., working within the successional pathways of different environments
- creation or maintenance of snags and coarse woody debris (CWD)

The *Northern Coast Range Adaptive Management Area Plan* (NCRAMA-1997) was intended to encourage the development and testing of new technical and social approaches to forest management through partnerships of land managers, scientists and citizens. Thus it provides some creativity and flexibility in management, and some opportunities for exploration and experimentation are created and sustained. The LSR designation is to "protect and enhance old-growth forest conditions," meaning that some management activities can take place where the purpose of the treatment is to benefit the creation and maintenance of late-successional forest conditions. Unlike LSRs outside of the AMA designation, treatments may occur in stands up to 110 years old.

For silvicultural prescriptions of CWD in managing plantations, a recommended "number" or volume is less important than an understanding of the dynamics of CWD, and particularly, a determination of whether the managed area is currently on the upward or downward trajectory of the curves supplied by this analysis. The importance of managing for CWD in plantations is to provide continuity, which is important for the succession of fungi and lichens. As with vascular plant succession, a much wider diversity of fungus and lichen species occur in mature and old-growth forests. However, many species of fungus and lichens appear to have much lower abilities to disperse and re-inhabit the environment after being absent.

The final objectives of stand characteristics should dictate the application of various silvicultural prescriptions. Care must be taken in applying silvicultural treatments that do not eliminate options to obtain key structural, functional or diversity components in the stand. The following analysis was done to determine a rough range of structural features and timber/fiber commodities that could be expected given certain silvicultural scenarios.

Silvicultural Treatments

Stand exam data are very limited in the analysis area, so a forest inventory plot taken eight years ago was selected to represent the average stand. Current Forest Inventory (CFI) Plot #377, located in the Upper Luckiamute subwatershed, was used as the average stand. This stand has a site index of 114, and consists of uniform, even-aged 25-year old Douglas-fir.

Table A.VII.-1. Current Forest Inventory (CFI; Plot #377)

Age	QMD[1] (quadratic mean diam.)	Average DBH (in.)	Height[2] (feet)	SDI (stand density index)[3]	RDI (relative density index)[4]	Crown ratio
30	**8.8"**	**8.7"**	**61**	**247**	**0.474**	**0.621**

1. QMD = DBH of tree of mean basal area
2. Height = Average height of the 40 largest trees
3. SDI = Trees per acre, adjusted to a 10" DBH
4. RDI = Ratio of SDI/TPA in fully stocked stand, adjusted to a 10" DBH; 0.35 indicates slowed growth due to competition, whereas 0.60 indicates mortality due to competition

For all management scenarios (see below) in the ORGANON (Willamette Valley version) model, the original trees per acre figure was too high, so a thinning to a stand density index of 200 was used to reflect a realistic stand at age of 25 years in this analysis area. At 30 years of age, four different management scenarios were imposed on the stand for modeling purposes:

Scenario #1: The stand was grown to 150 years of age with no treatment (beyond age 120, the model extrapolates).

Scenario #2: The stand was commercially thinned by basal area to 40 residual trees per acre and grown to 150 years.

Scenario #3: The stand was commercially thinned by basal area to 100 residual trees per acre and grown to 150 years.

Scenario #4: The stand was commercially thinned by basal area to 100 trees per acre at age 30, subsequently commercially thinned by basal area to 40 trees per acre at age 50, and grown to 150 years.

The model was not modified to show potential natural regeneration nor any underplanting; it only considered growth of the residual trees as directed by the particular management scenario. Table A.VII.-2 and Figures A.VII.-1-4 display the model results at 30, 50, 70, 100, 120 and 150 years of age for the quadratic mean diameter, height and the number of trees per acre (TPA) for each of the four management scenarios. These data were used to assess:

- changes in diameter over time and to look specifically at what treatments would reach an average of 24" DBH in the shortest time possible.
- the average number of live trees per acre over time.
- the rate of mortality and the time required for trees to die with a 24" DBH.

ORGANON model runs were also used to evaluate the long-term development of plantations under various silvicultural treatments. The charts which follow outline the levels of residual live trees, cumulative levels of snags and logs (mortality) over time, and the expected mean diameters of the stands in three (3) treatments, with "no action" as the control.

Table A.VII.-2. Management Scenarios and Tree Growth to 150 years

	1. No Action			2. Basal Area Cut to 40 TPA			3. Basal Area Cut to 100 TPA			4. Basal Area Cut to 100 TPA @ age 30, & Then Cut to 40 TPA@ age 50		
Age	**TPA**	**QMD**	**HT**	**TPA**	**QMD**	**HT**	**TPA**	**QMD**	**HT**	**TPA**	**QMD**	**HT**
30	301	8.8"	61'	40	11.5"	61'	101	10.4"	61'	101	10.4"	61'
50	267	13.5"	97'	39	20.9"	102'	98	18.0"	98'	41	20.0"	99'
70	212	16.9"	123'	39	28.6"	130'	94	22.5"	126'	40	27.0"	127'
100	140	22.2"	149'	38	35.5"	159'	85	27.0"	154'	40	33.7"	157'
120	111	25.6"	163'	38	38.6"	173'	78	29.8"	167'	39	36.8"	170'
150	84	30.1"	177'	37	42.0"	189'	68	33.2"	184'	39	40.1"	187'

Notes regarding Table A.VII.-2:

1. Numbers generated by growth and yield models can be used as a relative comparison of treatments in a given stand. The numbers are not necessarily accurate predictions of future growth, however, since future stand measurements are dependent upon disturbance patterns and other stochastic events which can never be predicted accurately.
2. Numbers for stands over age 120 are extrapolations and not based on stand data in the ORGANON model.

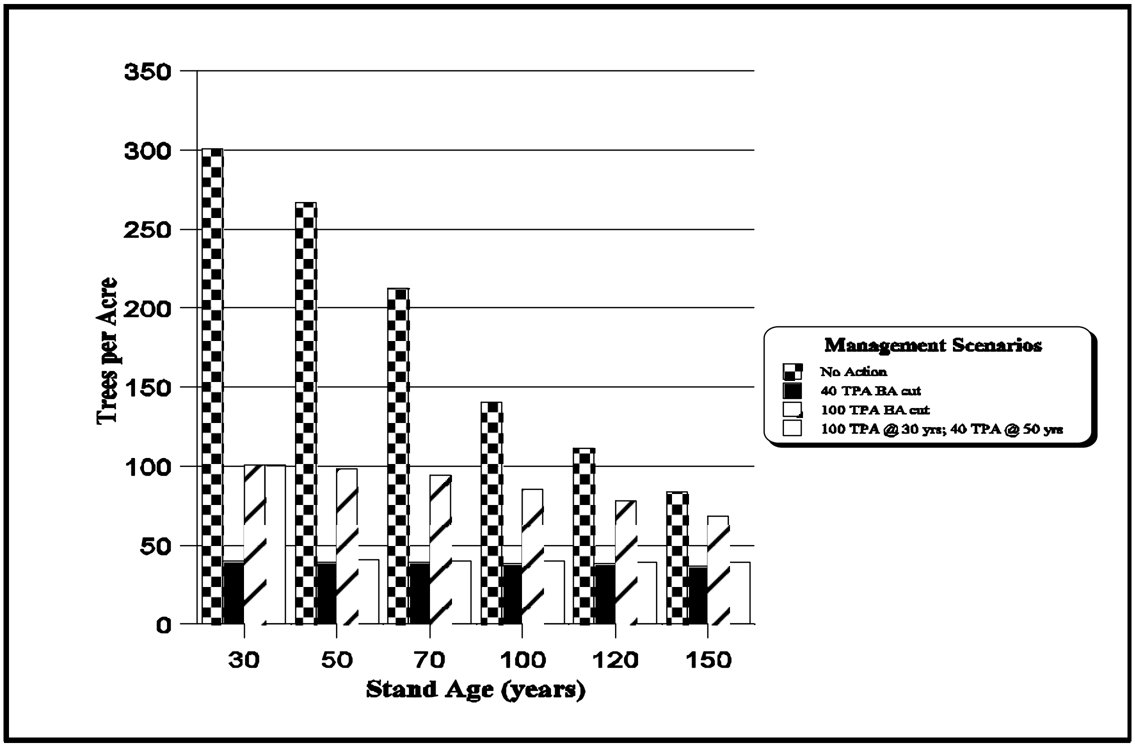

Figure A.VII.-1. Residual Live Trees under Various Stand Treatments

Another important factor determining habitat quality is the mortality within a stand over time. Standing dead and down trees contribute to ecological complexity, which can increase habitat quality and consequently diversity of species across a landscape.

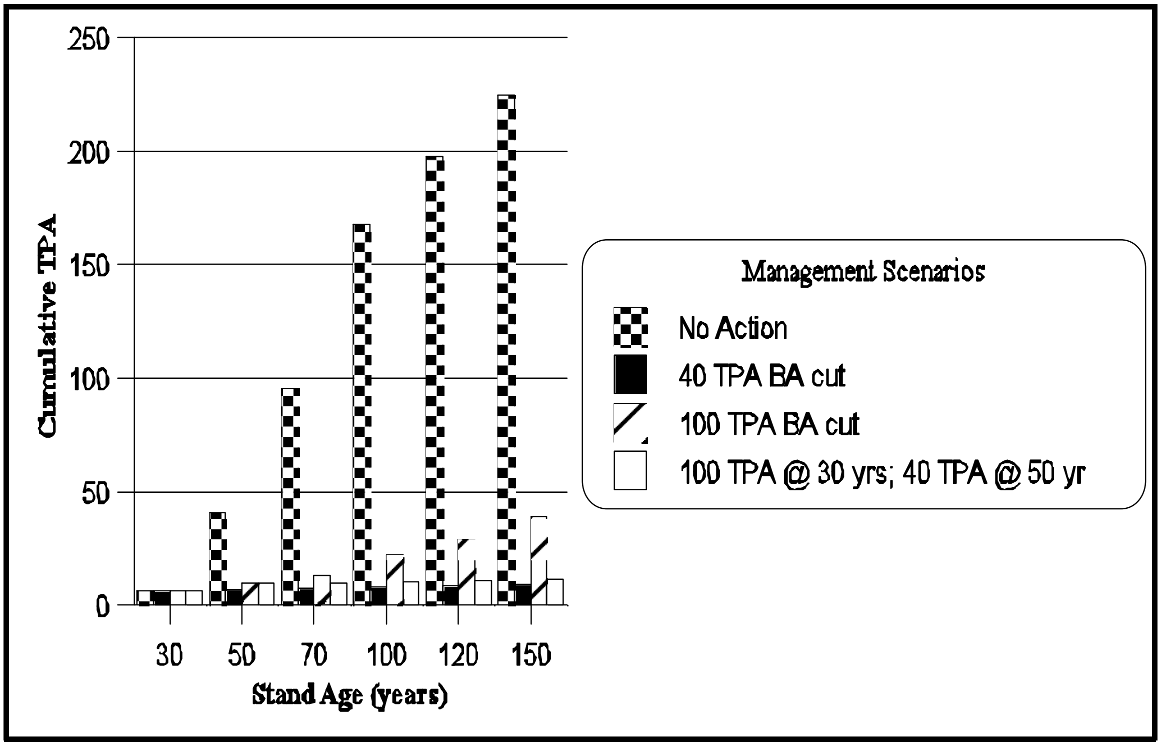

Figure A.VII.-2. Cumulative Tree Mortality Resulting From Various Silvicultural Treatments

In addition to the quantity of down wood as shown above in Figure A.VII.-2, the quality of down wood (features such as size and decay class) and arrangement should be a consideration for management. While all size classes serve an important ecological function, it is the larger diameter logs and snags that are important for many wildlife species. Large logs serve as den sites for marten and fisher, and retain moisture through the summer months, thus providing a habitat for terrestrial amphibians and small mammals. In addition, large wood lasts longer and decays slowly, increasing the number of species which utilize it over time. As Figure A.VII.-3 demonstrates, the time required to produce CWD with an average DBH of 24" is much longer for scenarios 1 and 3 (“ No action” and 100 TPA). Figure A.VII.-4 displays the quality of down wood under different management scenarios in creating CWD.

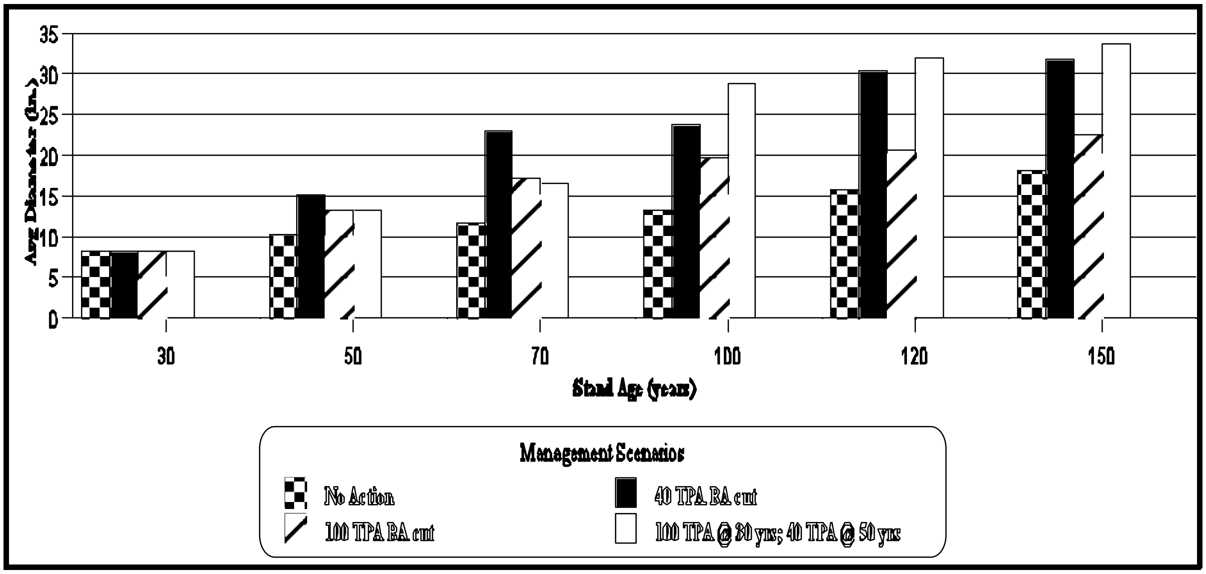

Figure A.VII.-3. Tree Mortality Diameters Resulting From Various Silvicultural Treatments

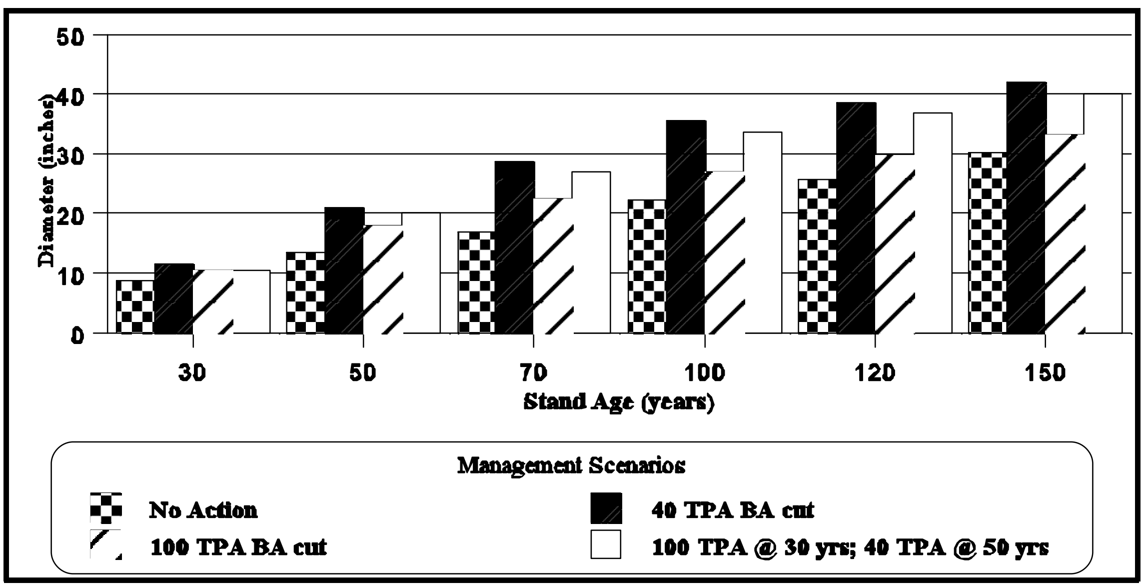

Figure A.VII.-4. Average Stand Diameters (Quadratic Mean at Breast Height) Resulting From Various Silvicultural Treatments

Figures A.VII.-1 through -4 display the results of some of the structural characteristics that could be expected (based on ORGANON modeling) given different silvicultural prescriptions. This information will assist in determining the appropriate forest management treatment based on the desired outcome. For example, if the desire is to produce the largest diameter trees as quickly as possible, thinning to 40 TPA at age 30 may be an appropriate application. However, if there is also a desire to allow for natural senescence of trees and a standing or down wood structural component in the stand, then perhaps thinning to 100 TPA by basal area is more appropriate. The "No action" option results in many trees per acre which die off due to competition, creating small diameter snags and down wood. By age 150, all treatments result in less than 80 TPA overall.

Based on the analysis above, and following guidelines developed in the NLSRA (BLM/FS 1997) and the AMA Guide (BLM/FS 1997), it was determined that within Late Seral Reserve boundaries a variety of silvicultural opportunities can be considered, including the "no treatment" option.

Silvicultural Projects

Early silvicultural projects are identified by vegetation surveys; acres are derived from AMA and LSR lands. The following describes the criteria that are used to identify early silvicultural treatment projects:

Site Preparation

Purpose: To reduce competing vegetation and logging debris (also reduces fire hazard), to provide room for seedlings to be planted, to lessen competition of seedlings with other vegetation and to limit cover for seedling-damaging rodents. Methods include prescribed fire, underburning, manual vegetation cutting, hand piling/burning (in fall), and mechanical clearing. (Note: In certain locations, close proximity to the Willamette designated airshed may preclude use of prescribed burning. Alternatives are available, as well as higher utilization standards during actual logging and yarding practices.)

Criteria for identification of projects:

1) Stands which have been regeneration harvested.
2) Hardwood conversion areas, i.e., those currently growing hardwoods, but which have the potential to grow conifer stands. (See "Stand Maintenance and Release" below.)
3) Stands planned for understory development and/or creation of a second canopy layer.

Stand Maintenance and Release

Purpose: To provide sufficient light and growing space for growing conifer seedlings.

Criteria for identification of projects:

1) Select units where hardwoods overtop conifers, or where competing brush threatens the survival or decreases the growth of conifer seedlings.
2) Select stands 3-15 years of age for best results.
3) Treat between June and August for most effective treatment.
4) Treat before conifer growth has slowed significantly from competition.

Young-Stand Density Management/Pre-commercial Thinning

Purpose: To promote desired species composition, stem quality (a goal in AMAs only), spacing, and growth performance in young stands by reducing the stem count. Typical spacings are from 12' x 12' to 16' x 16', but they can be variable.

Criteria for identification of projects:

1) Over-stocked, dense stands (generally with stem counts over 400).
2) Stands 10-20 years-old have usually reached the necessary height and crown closure to allow conifer release without also releasing competitive species.

Reforestation

Purpose: To plant regeneration harvest sites, within one year if possible, after site preparation has been completed. The selection of tree species, density, and stock type will depend on the site characteristics, stand composition, and future project management objectives.

Criteria for identification of projects:

1) Stands which have been recently regeneration harvested and on which site preparation has been recently completed.
2) Hardwood conversion sites which have been prepared for planting.
3) Stands identified for understory development (generation of second layer).

Early-commercial Thinning

Purpose: To promote desired species composition, stem quality (a goal in AMAs only), spacing, and growth performance in young stands (mostly 20-30 year-old stands) by reducing the stand density.

Criteria for identification of projects:

1) Over-stocked stands (generally with stem counts over 300).
2) Stands 20-30 years-old which have reached the necessary size to allow the harvest of conifers with enough merchantable material to produce a profitable sale.
3) Stands predominately containing slopes < 35%, allowing the operation of ground-based equipment.

Animal Protection

Purpose: To provide protection to seedlings from rodents and big game through the use of plastic tubing or netting around seedlings, or by trapping; to protect pre-commercially thinned stands from bear damage through the use of feeding or other methods.

Criteria for identification of projects:

1) Units where animal damage to planted seedlings is severe.
2) Units where stocking levels have fallen below desired levels due to animal damage.
3) Stands that have been thinned and are at risk for bear damage.

Fertilization

Purpose: To increase tree growth (volume) and improve the nutrient condition of soils.

Criteria for identification of projects:

1) Response to fertilization is usually greatest on sites deficient in the nutrients applied (i.e., generally, poor-quality sites usually result in a positive growth response).
2) Younger stands with early stocking control are usually favored for greatest response.
3) Timing of fertilization should be 10-20 years before the next thinning or final harvest to maximize the return from the treatment.
4) Minimal ground cover so that fertilizer reaches the seedling roots.
5) Combining fertilization with thinning, resulting in greater foliage biomass and photo-synthesis.
6) Fertilizing thinned stands result in a high value response due to gain in growth being distributed among fewer, larger stems.

Pruning

Purpose: Primarily to enhance future wood quality; secondarily, to reduce bear damage in thinned stands, thereby ensuring adequate tree quantities.

Criteria for identification of projects:

1) Stands with young trees, aged 15-50 years; may be performed several times.
2) Trees should be at least 4 inches diameter.
3) Trees with good growth form and minimal defect should be selected for treatment.
4) Best return is found on higher site class lands.
5) Stands that have been recently thinned or will be thinned within 5 years.

Hardwood Conversion

Purpose: To convert conifer sites currently dominated by hardwoods to conifers or a conifer-mix.

Criteria for identification of projects:

1) Hardwood-dominated stands which have the site potential to grow conifers.
2) Best return if stands are incorporated into planned thinning or regeneration harvest sales or are of a large enough magnitude to be performed separately as a treatment.
3) If converting red alder, best results if treated between mid-May and mid-July, a period starting after bud-break.

Special Forest Products (SFP)

Management of SFP is an important component of ecosystem-based resource management. Such a program can achieve the following objectives:

- complement other resource programs managed by the BLM
- contribute to the economic stability of local communities
- resolve some of the conflicts created by increased commercial and recreational harvesting of these forest products
- develop baseline inventory data for species now in demand
- form partnerships with groups concerned with the harvest and management of these products
- educate the public about the value of natural, renewable resources.

The increase in harvest of certain SFP such as moss and mushrooms will impact the populations of these products and associated resources (e.g., roads, trails). As demand for SFP grows, a rise in user conflicts is anticipated. Further, the seemingly growing numbers of SFP gatherers for whom English is a second language may require special attention to language and cultural needs.

Appendix VIII. Transportation Definitions

Access and Rights-of-way

As the patterns of land ownership became increasingly complex and intermingled, methods of permitting adjacent landowners to gain access to their property had to be reached. The most common instrument through which these agreements were (and are) reached is the "reciprocal right-of-way." With respect to BLM lands, a reciprocal right-of-way is an exchange of grants between the United States and a Permittee (usually, the adjacent landowner) which provides for each party using the other's roads or constructing roads over the other's lands. According to the RMP:

> "This plan will not repeal valid existing rights on public lands. Valid existing rights are those rights or claims to rights that take precedence over the actions contained in this plan. Valid existing rights may be held by other federal, state, or local government agencies or by private individuals or companies. Valid existing rights may pertain to mining claims, mineral or energy leases, easements, rights-of-way, reciprocal rights-of-way, leases, permits, and water rights."

Nothing in this watershed analysis document is to be construed as altering in any manner or form the valid existing rights referred to in the paragraph quoted above.

BLM Road Classification

Primary roads (arterial roads) are routes that link BLM secondary (collector) roads with State and county roads, and provide major access into and through BLM lands. These roads are generally bituminous surfaced and maintained frequently for use by the public to gain access to recreation sites or other points of interest. Some routes are designated as scenic or Back Country Byways in accordance with BLM regulations. (There are no primary roads designated in the analysis area of this watershed.)

Secondary roads (collector roads) are routes that have a definite terminus and are frequently used for transportation of forest products or dispersed recreation. These roads are generally surfaced with crushed rock, and are maintained annually or during sustained timber hauling.

Local roads are usually short (1 mile or less) and access specific resource management units where use is limited to short-term transportation of forest resources. Road surfaces can consist of either rock or natural surface. Typically, these roads are only maintained for short-term commercial use.

Appendix IX. Road Project Recommendations

Table A.IX.-1. Road Recommendations

ROAD NO.	RECOMMENDATION	PRIORITY
6-6-31	Replace 5 undersized or deteriorated stream culverts; maintain open for private timber haul, recreation access, and BLM density management.	Medium
6-6-32 (part)	Decommission (close w/earth berm and existing vegetation)	Low
6-6-32.1 (part)	Decommission (close w/earth berm and existing vegetation)	Low
6-7-28	Replace 13 undersized or deteriorated stream culverts; replace 7 deteriorated cross drain culverts; re-asphalt from M.P. 0.00 to M.P. 3.70; remove asphalt from M.P. 3.70 to M.P. 5.00; maintain open for private timber haul, recreation access, and BLM density management.	Medium
7-6-4	Remove slide blocking road and maintain for BLM density management.	Low
7-6-4.1	Decommission (scarify, water bar, seed, and close w/earth berm)	High
7-6-8	Replace 1 undersized stream culvert; maintain open for private timber haul, recreation access, and BLM density management. Decommission 0.80 mi., seg. O (scarify, water bar, seed, and close w/earth berm)	High
7-6-9 (spur unnum-bered)	Decommission (scarify, water bar, seed, and close w/earth berm)	High
7-6-9	Replace 3 undersized or deteriorated stream culverts; maintain for recreation and BLM density management.	Medium
7-6-9.1	Decommission (remove 1 culvert, scarify, water bar, seed, and close w/earth berm)	High
7-6-9.2	Decommission (remove 2 culverts, scarify, water bar, seed, and close w/earth berm)	High
7-6-17.1	Decommission (remove 2 culverts, scarify, water bar, seed, and close w/earth berm)	High
7-7-1	Replace 5 undersized or deteriorated stream culverts; maintain for recreation and BLM density management.	Low

ROAD NO.	RECOMMENDATION	PRIORITY
7-7-1.1	**Replace 12 undersized or deteriorated stream culverts; maintain open for private timber haul, recreation access, and BLM density management.**	**Low**
7-7-1.2	**Decommission (remove 2 culverts, scarify, water bar, seed, and close w/earth berm)**	**Medium**
7-7-2.1	**Decommission beyond junction with Road 7-7-2.4 (remove 2 culverts, scarify, water bar, seed, and close w/earth berm)**	**Medium**
7-7-2.2	**Replace 1 deteriorating stream culvert; maintain open for recreation access, and BLM density management.**	**Low**
7-7-3	**Decommission (close w/earth berm and existing vegetation)**	**Low**
7-7-4.2	**Decommission (close w/earth berm and existing vegetation)**	**Low**
7-7-5.1	**Decommission (remove 1 culvert, scarify, water bar, seed, and close w/earth berm)**	**High**
7-7-8.1	**Decommission (close w/earth berm and existing vegetation)**	**Low**
7-7-9.1	**Decommission (scarify, water bar, seed, and close w/earth berm)**	**Low**
7-7-11.1	**Decommission last 0.2 mi. (close w/earth berm and existing vegetation)**	**Low**
7-7-14.2	**Decommission (close w/earth berm and existing vegetation)**	**Low**
7-7-16	**Replace 6 undersized or deteriorated stream culverts; maintain open for private timber haul, recreation access, and BLM density management.**	**High**
7-7-21	**Decommission (water bar, seed, and close w/earth berm)**	**Low**
7-7-22.3	**Replace 1 deteriorating stream culvert; maintain open for recreation access, and BLM density management. Decommission last 0.30 mi. (water bar, seed, and close w/earth berm)**	**Medium**
7-7-23.2	**Decommission (close w/earth berm and existing vegetation)**	**Low**
7-7-25.1	**Decommission (scarify, water bar, seed, and close w/earth berm)**	**Medium**
7-7-26.1	**Decommission (close w/earth berm and existing vegetation)**	**Low**
7-7-27	**Decommission (remove 2 stream culverts, scarify, water bar, seed, and close w/earth berm)**	**Medium**

ROAD NO.	RECOMMENDATION	PRIORITY
7-8-24.2	Replace 10 undersized or deteriorated stream culverts; install 8 new culverts or drain dips; decommission last 0.5 mi. (water bar, seed, and close w/earth berm); maintain for recreation, private timber haul, and BLM density management.	High
8-6-30	Decommission (remove 2 stream culverts, scarify, water bar, seed, and close w/earth berm)	Medium
8-7-3	Replace 3 undersized or deteriorated stream culverts; install several new crossdrain culverts or drain dips; maintain for private timber haul and BLM density management.	High
8-7-9	Decommission segment between Road 8-7-9.1 and Road 8-7-10.3 (scarify, water bar, seed, and close w/earth berm)	High
8-7-25	Decommission (remove 1 stream culvert, scarify, water bar, seed, and close w/earth berm)	Medium
8-7-25.1	Decommission (water bar, seed, and close w/earth berm)	Low
8-7-25.2	Decommission (water bar, seed, and close w/earth berm)	Low
9-6-7.3	Decommission (remove 1 stream culvert, scarify, water bar, seed, and close w/earth berm)	Medium
9-7-9.3	Decommission (remove 2 stream culverts, scarify, water bar, seed, and close w/earth berm)	Medium
9-7-11.2	Decommission (scarify, water bar, seed, and close w/earth berm)	Low
9-7-14	Replace 2 deteriorating log structures with metal culverts/pipe arches (one needs fish passage); maintain for recreation, private timber haul, and BLM density management.	High
9-7-15	Decommission (remove 3 stream culverts, scarify, water bar, seed, and close w/earth berm)	High
9-7-20.2	Decommission (scarify, water bar, seed, and close w/earth berm)	Low
9-7-21.1	Decommission (remove 2 stream culverts, scarify, water bar, seed, and close w/earth berm)	Medium
9-8-10	Decommission (remove 3 stream culverts, scarify, water bar, seed, and close w/earth berm)	Medium
9-8-15	Decommission (remove 1 stream culvert, scarify, water bar, seed, and close w/earth berm)	Medium

ROAD NO.	RECOMMENDATION	PRIORITY
9-8-26	**Decommission (remove 1 stream culvert, scarify, water bar, seed, and close w/earth berm)**	**Medium**
9-8-36.4	**Decommission (scarify, water bar, seed, and close w/earth berm)**	**Low**

Note: This table is not an exclusive listing of all potential road related projects. Any projects not listed here but which may be considered for implementation will comply with the recommendations described in Chapter IV.

Appendix X. Road Stream Crossing Projects Criteria

Introduction

In general, to meet Aquatic Conservation Strategy objectives, it is best to avoid new road construction in Riparian Reserves. The current planning process for new road construction requires the involvement of affected resources specialists, including the hydrologist, soils scientist, botanist, wildlife biologist and/or aquatic biologist, and road engineer. At the present time, the Best Management Practices are being used to help determine the road location, general road design features, design of cross drains and stream crossings, as well as the actual road construction.

Roads

Continue this interdisciplinary process of evaluating each new road proposal, and when needed, utilize specialists from outside the agency to verify findings. When interdisciplinary teams are considering proposals for constructing road crossings on stream channels (as defined in the ROD), the following methodology is recommended:

Rosgen (*Applied River Morphology*, pp. 29-33) has published a method for characterizing channel stability which combines his channel classification system with the Pfanuck stability index. This approach requires a field visit to the sites in question, and the end product is a channel stability rating of poor, fair, or good. By combining this rating with a matrix which identifies the beneficial uses identified in the watershed, a numerical "Risk Rating" from 1 to 12 can be displayed, as below:

Beneficial Use	Good Stability	Fair Stability	Poor Stability
Extremely High	**9**	**11**	**12**
High	**6**	**8**	**10**
Moderate	**3**	**5**	**7**
Low	**1**	**2**	**4**

The "beneficial use" rating is as follows:

Extremely High = Habitat for listed species or a combination of two or more high uses.
High = Anadromous fishery or municipal watershed or combination of two or more moderate uses.
Moderate = Domestic water supply, non-anadromous fish, recreation.
Low = Irrigation, livestock, or other.

This rating does not imply that the crossing can or cannot be constructed in a manner that will preclude direct, indirect or cumulative effects; the potential for effects must be identified in the environmental assessment document, as always. The rating does provide a consistent and reproducible method for assigning risk, and it allows for a comparison of relative risk levels from project to project.

To test its usefulness, it is recommended that this method be applied on an interim basis by interdisciplinary teams considering proposals for road construction across streams. [This approach will also be presented to the District Soil-Water Working Group for evaluation and adaptation.]

MAP PACKET

Map Packet #	Map Title
MP-1	Slope Hazard
MP-2	Landslides & Slide Tracks
MP-3	Conifer Forest Seral Stages/Habitat Types
MP-4	Riparian Reserves
MP-5	Riparian Reserve Connectivity
MP-6	Stream Bank Vegetation Shade & Water Temperature
MP-7	Potential for CWD in Streams
MP-8	Stream Channel Classification
MP-9	Water Quality Limited Streams
MP-10	Density Management Opportunities